ENGINEERING AND MINING JOURNAL

APRIL, 1941

APR 24 1941

Union Potash surface plant and refinery from the air, on the plains 15 miles east of Carlsbad, southeast New Mexico

In this issue

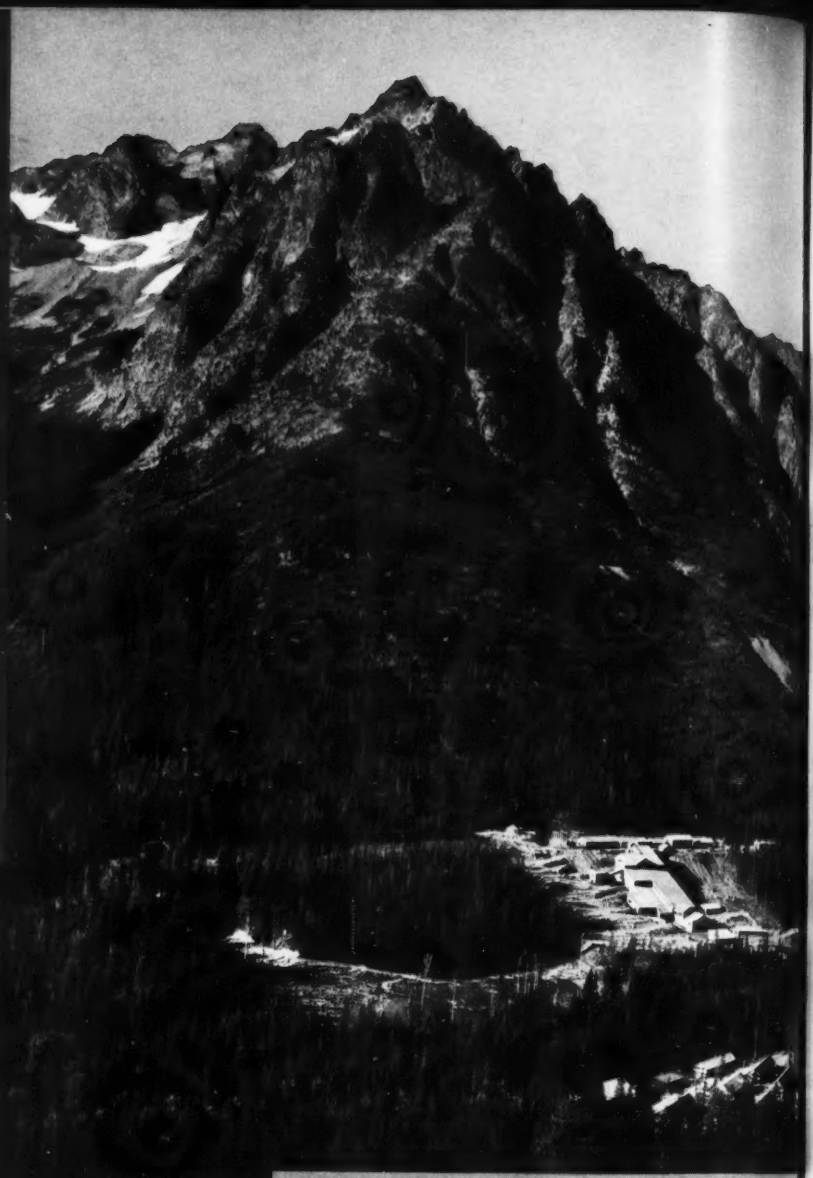
The Union Potash & Chemical Co.'s Enterprise

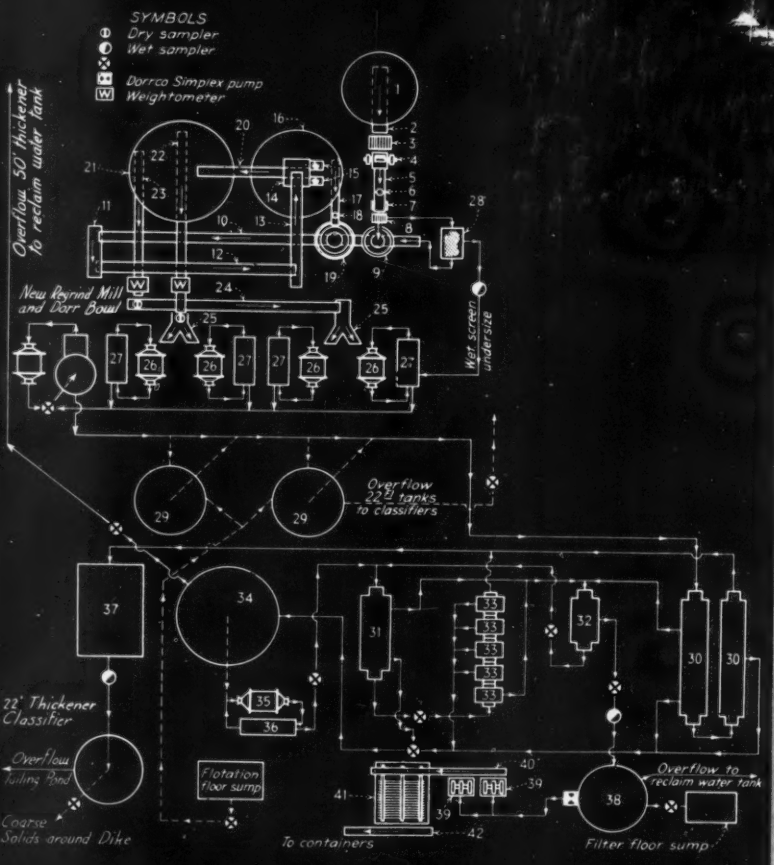
—Newest Project in the Carlsbad Potash Field

—Development • Construction • Current Operations

Complete Contents on Page 37

9 of these 11 HYDROSEAL PUMPS in Service nearly 3 YEARS





One C-Frame, six B-Frame and four A-Fram Hydroseal Pumps are now in service at this larg copper mine, as indicated by the black marks o the flow sheet. Nine of these pumps have bee in service nearly three years, and some of the still have their original Maximix Rubber Pumpin Parts (Shell Liner, Impeller, Side Plate Liners, etc.) All of these pumps are equipped with Overhea Motor Bases . . . As suggested by the above photograph, this mill is so situated that maximu reliability and freedom from pumping troubles ar vital . . . As we have received two repeat order since the original nine Hydroseals were installed we believe no more need be said, other tha that we'd like you to address the nearest offic listed below for a copy of our Catalog No. 14

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The Morenci project, begun by Phelps Dodge more than three years ago and involving the expenditure of $35,000,000, is moving swiftly to the production stage, to be reached early in 1942. The status of the open-pit development of the large low-grade deposit of copper ore and of the plant construction, as noted on a recent visit, will be described next month by John B. Huttl.

▼

Quicksilver's rôle in rearmament is important — too important to permit needless waste, especially when the market price is above $180 per 76-lb. flask, as at the present time. Losses of the metal in furnacing the ores will be dealt with by H. J. Morgan, consulting engineer, in the May issue. Of particular interest, Mr. Morgan will describe an improved portable apparatus for determining the amount of mercury lost in condenser gases.

▼

Changing practice in open-pit mining on the Lake Superior iron ranges has been the subject of numerous articles in *E.&M.J.'s* pages in the last few years. In reality they record an important transition from long-established methods of handling ore between the shovels on the benches or in the bottom and the railroad pocket or washing plant on the surface—a transition not yet complete. A notable instance of such change was furnished in the 1940 season by the Canisteo mine, on the western end of the Mesabi. Here, instead of steam haulage to a distant plant on the surface, trucks were used to carry the ore to a crushing plant in the bottom and a 1,000-ft. 18-deg. conveyor system was installed to deliver it from the crusher to the concentrator, which had been moved to the pit edge. The story will be told next month by W. A. Sterling, Cleveland-Cliffs' Mesabi district superintendent.

H. C. PARMELEE
Editor

ENGINEERING AND MINING JOURNAL

H. W. CLARKE
Vice-President

Published by McGraw-Hill Publishing Co., Inc.

Contents for APRIL 1941

Vol. 142, No. 4

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The Union Potash & Chemical Co.'s Enterprise at Carlsbad 43-71
A. H. Hubbell

History of District and Company . . . The Local Geology 43-48

Opening the Mine . . . The Shafts . . . The Mining Method 48-50

The Development Campaign and 900 Level Operations 51-57

Mining on the 800 Level . . . Shuttle Car Transport 58-60

Ventilation . . . Sampling . . . Power Distribution 61-64

The Refinery and Its Operations 65-71

Useful Operating Ideas 72

Summary of the Markets 74

Personals 77

Obituaries 77

Letters 78

News of the Industry 81

Equipment News 107

COVER ILLUSTRATION: Union Potash surface plant and refinery from the air, on the plains 15 miles east of Carlsbad, in southeastern New Mexico. Photograph by Ray V. Davis, Carlsbad.

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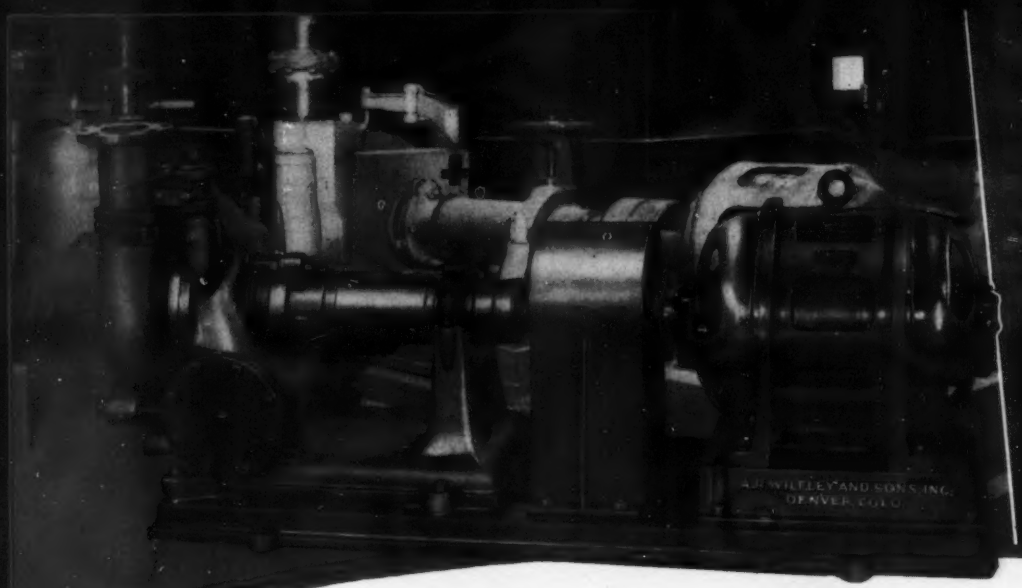
Publication Office: 99–129 N. Broadway, Albany, N. Y.

Editorial and Executive Offices: 330 W. 42d Street, New York, N.Y. Cable Address: McGraw-Hill, New York

Branch Offices: San Francisco, 68 Post St.; Chicago, 520 N. Michigan Ave.; Washington, D. C., National Press Building

McGRAW-HILL PUBLISHING COMPANY, LTD.
Aldwych House, Aldwych, London, W. C. 2, England Cable Address: Backlash, Estrand, London



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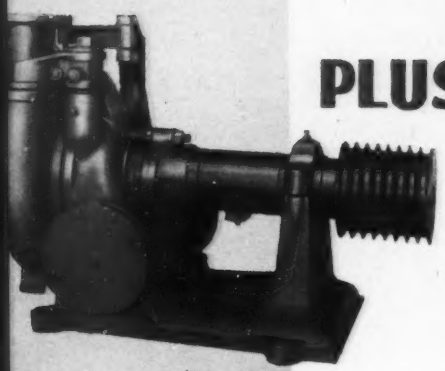

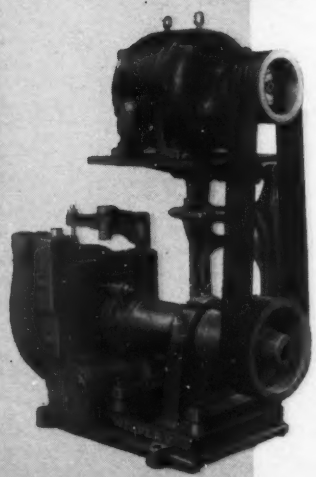

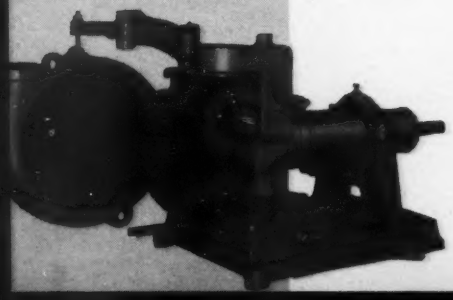

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Volume 142 APRIL, 1941 Number 4

The Union Potash Enterprise

IN THIS ISSUE, without apology for its length, we present a description of the plant and operations of the Union Potash & Chemical Co., the newest entrant into the Carlsbad potash field. As a story of the swift, efficient execution of a difficult task by a mining company and its staff of engineers the account should be interesting to many readers. As the first detailed narrative to be published on the mining and ore-treatment practice of any of the three companies in the district, the article also invites attention. The enterprise itself, viewed broadly as the present culmination of the efforts of more than 20 years to free the United States from dependency on foreign sources of potash, merits the spotlight at this crucial time, now that such independence has surely been attained.

Those who guide the affairs of the Union Potash company and its parent organization, the International Agricultural Corporation, which is one of the largest consumers of potash in the country, are to be commended for their shrewd ability to foresee and seize so excellent an opportunity to serve their country and their companies by a bold business stroke. Though the enterprise had been previously planned, the decision to push the program of underground development and plant construction was timed exactly, so that the resulting new production became available just when an increase in the country's domestic output was wanted.

The Union company and its staff are also to be commended for pioneering with new equipment in a field that was also new to them both technically and geographically. In particular, its employment of rubber-tired shuttle cars in a trackless-trolley system for moving sulphate ore on the 800 level is unique in mining. Its underground operations are wholly mechanized, especially loading, and almost entirely electrified. It has already attained a high efficiency in operation. Because of such considerations and because few companies and engineers outside the coal industry have had experience with the mining method used, the story of this Carlsbad enterprise, it is hoped, will prove worth the reading.

Collar-to-Collar Vs. Face-to-Face

BECAUSE his final interpretation of "hours worked" in metal mines was diametrically opposite to what was expected we invited Colonel Fleming to reconcile his various statements on the subject. His reply appears on page 88. It is a frank admission of the gradual education of a sincere public official, and of the confusion growing out of his early unfamiliarity with an industry. Fundamentally, however, the difficulty is beyond Colonel Fleming's responsibility. It lies in the passion of the New Deal to regulate the habits and customs of all industry in an attempt to remedy recognized abuses in a small segment. Since NRA days it has been abundantly demonstrated that the United States is too large, its industry is too complex, and its business customs are too diverse to be regimented successfully by zealous reformers, however well intentioned. The wage-hour law is merely one example of such an effort. It has been unsatisfactory to operators and miners alike, as well as a headache to the Administrator.

Drilling by "Burning"

A LITTLE OVER A YEAR AGO experiments in various methods of drilling non-combustible materials through the use of the oxy-acetylene flame were undertaken by engineers of the Linde Air Products Co., a unit of Union Carbide & Carbon Corporation. Since that time this work has been carried on with encouraging results, both in the laboratory and in the field on an experimental basis. Up to this point, however, no final conclusions have been developed. The experimental work is still going on in various sections of the country and in various types of formations. A number of types of equipment have been used for work under varying conditions, and to accomplish various kinds of results. Engineers of the Linde company say that as soon as sufficiently conclusive data are developed to make possible any general deductions, these will be made available to the mining industry. Their results will be awaited with unusual interest.

Inquiry into Zinc Industry

WITH A REMARKABLE GIFT for ineptitude the anti-trust division of the Department of Justice has chosen the present critical moment to look for evidence of illegal trade agreements in the zinc industry. Someone ought to tell this branch of the New Deal that the country is involved in war; that the zinc industry is a vital arm of national defense; that it is preoccupied with a tremendous program of expanding production; that it has contributed magnificently to the supply of munitions; that it has already been harassed by inexcusable labor quarrels; and that it can ill afford to be distracted from its job of production by an untimely inquiry into production and prices.

Whatever the suspicions of the Department of Justice as to whether Prime Western zinc reached its present price by natural causes, the inquiry could be made later just as well as now. For ourselves, we have sufficient confidence in Commissioner Leon Henderson as a price policeman to believe that something would have been done long ago about the price of zinc if the rise had been considered unreasonable or the result of manipulation. In fact, in his announced intention to bring the price of secondary zinc into line with that of primary, Mr. Henderson stated that the latter had been stable for months under demand conditions that normally would have permitted a rising price. As a measure of national defense, the Department of Justice inquiry doesn't merit high priority.

Forty Years of Research

LONG BEFORE industrial laboratories were a commonplace in the United States, research and General Electric were synonymous. To speak of research was to conjure up a picture of the famous laboratory at Schenectady that made such notable contributions to pure science and industrial progress. And synonymous with the fame of the laboratory was the genius and eminence of the director, Dr. Willis R. Whitney. The man, the laboratory, and the company combined to make history in the field of industrial research.

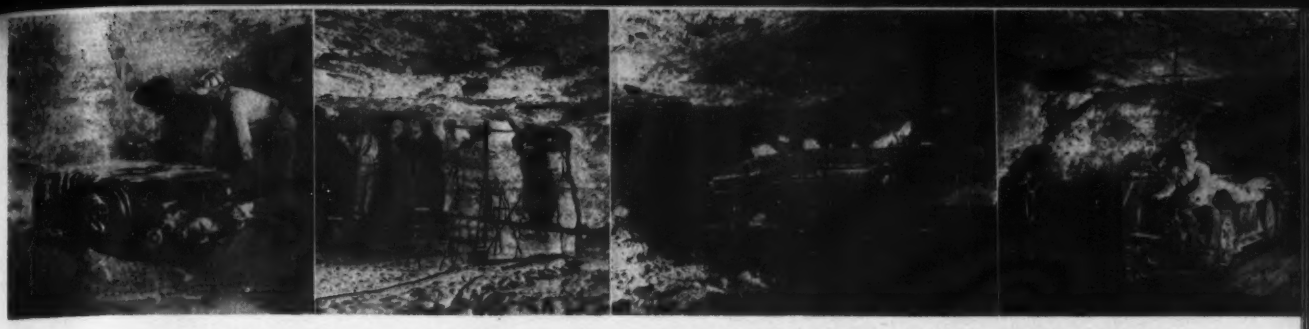
After the lapse of forty years one is apt to lose sight of the simple beginnings of an institution so well established as the General Electric research laboratory. So it is well to be reminded that it was first set up inauspiciously in a barn in the rear of the home of Dr. Charles P. Steinmetz; that it was moved to a new building only after the barn burned; and that years elapsed before it had a home in keeping with its importance and dignity. Significant also is the fact that Dr. Whitney, then on the faculty of Massachusetts Institute of Technology, commuted from Boston to Schenectady three times a week to work with Dr. Steinmetz and direct the staff of one man. Obviously the laboratory itself was an experiment, and made headway slowly.

Credit for the magnificent institution and organization that evolved from this simple origin cannot be adequately allocated. But at least one can recognize the inspiration of Steinmetz and Albert G. Davis, patent attorney, who suggested the idea; the business foresight of E. Wilbur Rice, Jr., vice president, who acted upon it; the courage of the board of directors that approved it and gave it financial support; and the guiding genius of Dr. Whitney, who developed men as well as methods. Those who have followed in their footsteps are the beneficiaries of pioneers who broke new ground forty years ago.

We're 75 This Year

IT WAS IN 1866 that the *American Journal of Mining* was founded and destined to become in 1868 the immediate ancestor of *Engineering and Mining Journal*. Like other business institutions, it was established because the publishers were men of hopeful enterprise and foresight. How well they and their successors built is attested by the continuous and uninterrupted publication of the *Journal* for 75 years. The occasion seems worthy of commemoration because few industrial or technical papers can point to such a long and virile existence. And so next August we shall publish a diamond jubilee number that will fitly mark the importance of an industry of which *E.&M.J.* has been a vital part for three-quarters of a century.

Later we shall have more to say about the August number and its contents, but for the moment we address ourselves to the venerable subscribers of *Engineering and Mining Journal* who began reading it fifty years or more ago. We mention the half-century mark because we already know of subscribers who have taken the *Journal* for fifty years, and we want to compile a complete roster of the "Fifty-Year Club." So if you first subscribed to *E.&M.J.* fifty years or more ago, please send the editor your name and other pertinent details. And if you happen to have any photographic views of old mining camps of the West, we shall welcome the opportunity to copy them. "Old-Timers"—men and places—will lend to our anniversary number a flavor of early mining days.



Underground in the Union Potash mine. Operations are entirely mechanized and almost wholly electrified. Left to right, undercutting, electric drilling, loading, and transport in both mine cars and trackless-trolley shuttle cars

The Union Potash & Chemical Company's Enterprise at Carlsbad

With a new mine and plant in the New Mexico potash field, in the Southwest, this subsidiary of the International Agricultural Corporation is the latest entrant into producers' ranks

A. H. Hubbell
Associate Editor

LESS than a quarter century ago, in the first World War, potash, then prominent on our list of essential but deficient minerals, gave wide concern by reason of its deficiency. The tonnage required for domestic purposes had been brought in almost entirely from abroad, and the net effect of war conditions was to reduce imports to the vanishing point. Of first importance as a raw material in the production of fertilizers[1] and potassium-bearing chemical compounds as well as in glass and ceramic manufacture, potash became the object of a search that overlooked no likely source and that yielded a maximum production of 54,803 tons of K_2O in 1918, this from 128 plants in 21 States and Puerto Rico, at a time when the market price was abnormally high and before foreign supplies again became available. This experience was beneficial and inevitably spurred the investigation that was to be so profitable of the potash-producing possibilities of the so-called Permian Basin of the Southwest, of which the Carlsbad region in New Mexico is part.

It is this Carlsbad area that is now yielding the major part of the country's production of potash salts. Here, some miles east of the town itself, on lands largely leased from the Federal Government and the State of New Mexico, two companies have been mining and refining potash salts for several years — one, the United States Potash Co., since 1932, and the other, the Potash Company of America, since 1935. A third operator, the Union Potash & Chemical Co., entered production in the fall of 1940, after doing some remarkable work in opening its mine and erecting a refinery and other necessary surface plant. This newest entrant into the field is a subsidiary of International Agricultural Corporation, which is an important miner of phosphate rock in the Florida and Tennessee fields[2] and which some years ago also owned a potash mine in Germany as a source of its potash requirements. The new enterprise of the Union company in its various aspects provides the subject of this article.

The possibilities of the Permian salt basin with respect to potash seem to have first been suggested by the U. S. Geological Survey[3] in 1910. That the idea was justified was demonstrated the following year when what is regarded as the initial discovery of potash in the basin was made in Dickens County, Texas, by J. A. Udden,[4] of the Texas Bureau of Economic Geology, in the brine of a well that had been drilled for water. This was followed by further finds in various wells. Certain potash minerals derived from boreholes were next identified—polyhalite first in 1921, in cuttings from Midland County, Texas, in the laboratory of the U. S. Geological Survey, and sylvite with strong showings of polyhalite in 1925, in the course of the Snowden-McSweeney-McNutt oil test, in the Carlsbad area, a dozen or more polyhalite beds being found meanwhile in the intervening period, some of which might be worked today were it not for other superior deposits subsequently discovered in the Basin.[4]

Much remained to be learned, however, before the point of commercial exploitation was reached, and in 1927 a core-drilling campaign to explore the strata of the Permian basin was undertaken jointly by the U. S. Geological Survey and the Bureau of Mines, under powers granted and with funds provided by Act of Congress the year before. In the next five years 23 holes were drilled for potash in the Basin by the Government. The results obtained, together with those yielded by some 71 core tests privately made and the additional information derived by

[1] There are three main ingredients of commercial fertilizers: nitrogen, phosphates, and potash. Nitrogen is found in many forms; phosphates are mined in this country, principally in Florida and Tennessee.

[2] The operations of International Agricultural Corporation in Florida and Tennessee are described in the September, 1940, and January, 1941, issues, respectively, of *E. & M. J.*, in the article "Phosphate—The Vital Non-Metallic," by A. H. Hubbell.

[3] H. I. Smith, *E. & M. J.*, Dec., 1933.

[4] Bulletin 12, New Mexico Bureau of Mines, by S. B. Talmage and T. P. Wootton.

the Government from a study of cuttings from holes drilled for oil, made it possible to delineate the part of the Basin most promising for commercial development. Of the 94 holes put down, 81 were in New Mexico and 13 in Texas.

The Permian salt basin, in the main a subsurface feature broad and relatively flat, covers parts of five States, reaching from southeastern New Mexico, in the neighborhood of Carlsbad, up into Colorado and eastward into Kansas, Texas, and Oklahoma. It contains one of the largest salt deposits known, formed one way or another by evaporation of salt water, this presupposing an ancient connection with the Gulf. In the Carlsbad area, the salt series has a maximum thickness of over half a mile.[5] The salt is enclosed above and below in Permian sedimentaries, with still other sedimentaries above and below the Permian.

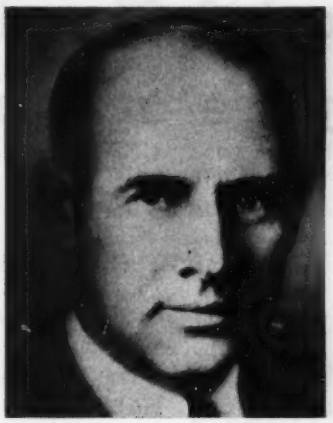
Potash minerals have been found, in borehole cuttings and cores, over an area of some 40,000 sq.mi. within the irregular limits of the Basin,[6] which has been examined in its entirety in respect to potash only to the extent that is possible with an average of one core test for every 500 sq.mi. These holes, of course, have not been uniformly spaced. Most of them have been drilled in a fraction of the total area, some 3,000 sq.mi. in extent, which has one core test for every 50 sq.mi. and which is considered promising as to potash minerals other than polyhalite. It centers about 35 miles east of Carlsbad, being about 80 miles from north to south and about 50 miles across in its widest part, which is almost due east of the town, with merely its southern tip projecting downward into Texas.

In turn, 50, or five-sixths, of the holes in this 3,000-sq.mi. tract are concentrated in the 100 sq.mi. nearest the town of Carlsbad and approximately one-third of this has thereby been shown to contain sylvite four or more feet thick and running up to 25 and 30 percent in content of K_2O. It is in this residual fraction of the Basin that the present commercial exploitation by the Union Potash company and its neighbors is under way. The Union company also has an extensive persistent bed of the double-sulphate, langbeinite, of workable grade and thickness.

The story, thus outlined, of the way in which this country has been freed from its former dependence upon European producers for its supply of potash, has been told[7] more than once at length, particularly by H. I. Smith, chief of the Conservation Branch of the U. S. Geological Survey, which is charged with the administration of all exploratory and mining operations conducted by private interests upon the Federal lands leased by them from the Government. It is thrilling, especially in view of the seeming hopelessness of the domestic potash situation at the outset and the fact that the potash beds found are buried hundreds of feet beneath the surface with an utter absence of those indications of mineralization upon which the prospector customarily depends.

Existence of as many as 40 beds[8] containing potash salts has been disclosed, according to Mr. Smith in the first article credited to him in footnote reference 3. A distinct succession has been determined in the productive Carlsbad district, making correlation possible over an extensive area. Twenty-four different minerals have been found in the cores and cuttings, including the following potash minerals.

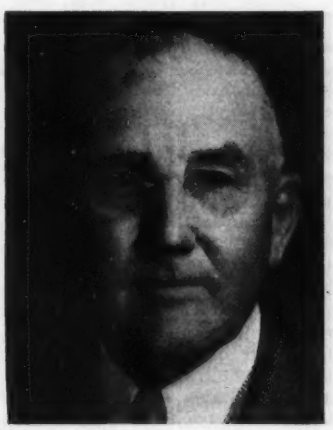
1. Polyhalite, K_2SO_4, $MgSO_4$, $2CaSO_4.2H_2O$, containing 15.6 percent K_2O



Louis Ware, chairman of the board of Union Potash & Chemical Co. and president of International Agricultural Corporation

John T. Burrows, president of Union Potash & Chemical Co. and vice president of the parent International Agricultural Corporation

Charles E. Heinrichs, vice president, Union Potash & Chemical Co. and director of research of the I.A.C.



James A. Barr, chief engineer of Union Potash & Chemical Co. and of the I.A.C., New York

2. Sylvite, KCl, containing, pure, 63.17 percent K_2O

3. Kainite, $KCl.MgSO_4.3H_2O$, 18.91 percent K_2O

4. Carnallite, $KCl.MgCl_2 + 6H_2O$, 16.95 percent K_2O

5. Langbeinite, $K_2SO_4.2MgSO_4$, 22.7 percent K_2O

6. Leonite, $K_2SO_4.MgSO_4.4H_2O$, 25.69 percent K_2O

7. Aphthitalite $(K,Na)_2SO_4$

Of these we are concerned only with

[5] Bulletin 12, New Mexico Bureau of Mines.

[6] "Government Potash Exploration in Texas and New Mexico," by G. R. Mansfield and W. B. Lang, T. P. 212, A.I.M.E. 1929. Also H. I. Smith, *E. & M. J.*, Dec., 1933.

[7] "Potash in the Permian Salt Basin," H. I. Smith, *Ind. and Eng. Chem.*, Aug., 1938. Also "Three and a Quarter Centuries of the Potash Industry in America," H. I. Smith, *E. & M. J.*, Dec., 1933. Also "The Potash Industry in the United States," J. J. Bourquin, *Min. Cong. Journal*, Jan., 1937.

[8] Most of these are, of course, uncommercial either in thickness or grade or both, at the present time.

Surface plant and refinery of Union Potash & Chemical Co., as viewed from the air. The site is at No. 1 shaft, the headframe of which is seen at left and is 15 miles east of Carlsbad. Nearest the camera are, left to right, the crushing plant connected by conveyor gallery with the refinery and, at extreme right, part of the storage building. This aerial view was taken by Ray V. Davis, Carlsbad

Right, a closer view of the headframe and ore bins at No. 1 shaft, the crushing plant, and, at the extreme right, the bins for storing crushed ore

Harold S. Martin
Manager, Union Potash & Chemical Co.
Carlsbad, New Mexico

Below, the refinery, the end of which is seen at the right, delivers its finished products by covered conveyor to the storage building at the left

the chloride, or sylvite, and the double sulphate of potash-magnesia, or langbeinite, these composing the two ores mined by Union Potash from separate beds on respective levels.

The principal non-potash minerals are halite, NaCl; anhydrite, $CaSO_4$; gypsum, $CaSO_4.2H_2O$; and kieserite, $MgSO_4H_2O$. Here, again, we are concerned only with the halite, or common salt, it constituting the bulk of the waste broken in the Union mine in the course of development or mixed with the ores as they are mined.

The Company—Its Holdings

Although the Union Potash & Chemical Co. has entered only recently into active work in developing and mining potash ore and the subsequent refining of the crude material, it has had a corporate existence for several years. It was formed as a Colorado corporation in January, 1936, as a result of the pooling of the potash permits held by Texas Potash Corporation and Independent Potash & Chemical Co. Negotiations were opened in the summer of 1936 with International Agricultural Corporation soliciting its assistance and cooperation in the development of the properties.

Louis Ware, of New York, president of the International Agricultural Corporation, is chairman of the board of the Union Potash & Chemical Co. John T. Burrows, vice president of the parent I.A.C., is president of the Union company. C. E. Heinrichs, as director of research of the I.A.C., is a vice president of the Union company and was largely responsible for the development of the processes that are being used in the refinery. James A. Barr, also of the parent organization in New York, is consulting engineer, with L. E. Young as consulting mining engineer. Harold S. Martin is manager with offices at the mine. G. T. Harley is general superintendent and W. P. Morris, assistant mine superintendent. J. A. Mackenzie is refinery superintendent; P. S. Fagen, power superintendent and master mechanic; J. P. Burrows, purchasing agent and assistant to the manager; L. E. Dupont, chief chemist; D. MacLachlan, chief accountant; and E. C. Anderson, plant engineer.

Other members of the staff are as follows: B. W. Jacobs, general refinery foreman; J. Kartchner, mine foreman; J. L. Prewett, assistant master mechanic; E. Hauzer, chief electrician; S. Monroe, power foreman; A. C. Rogers, shop foreman; T. C. Onstatt, carpenter foreman; G. B. Bonham, mine surveyor; and M. J. Sheridan, safety engineer.

Acknowledgment and thanks are due to the management and the various members of the staff for the numerous courtesies and kindly assistance extended to me during my visit to the property in the latter part of January and in February for the purpose of gathering data and illustrations for this article. In particular I feel greatly indebted to Mr. Martin and to Messrs. Harley, Morris and Mackenzie, who gave me freely of their time and their knowledge and advice to no little extent.

The Union Potash company's properties in the Carlsbad field consist of approximately 7,500 acres of leased ground in the open country east of Carlsbad, a region that is classified as being part of the Great Plains. No. 1 shaft, at which the local headquarters office, refinery, and shops are situated, is 26½ miles by road from the town, or approximately 15 miles due east in an airline. More precisely, its location may be defined as in Eddy County, in the northeast quarter of Section 12, Township 22 South, Range 29 East. Here are the headframe and shaft bins, the office and the refinery, together with the building and bins for storing and loading the finished products, as well as the usual shops and miscellaneous other structures. No. 2 shaft is 4,100 ft. away.

The surrounding region is part of the so-called high-plains area of southeastern New Mexico, the elevation of the collar of No. 1 shaft being 3,215 ft. (The elevation of the town of Carlsbad is 3,111 ft.) The gently rolling country is semi-arid and sparsely grassed, with water holes infrequent so that, though classed as grazing land and fenced outside of the potash company's holdings, it supports but a few head of cattle per acre on the average. Save for the plants of the Union company and its two neighbors some miles away, it is largely uninhabited. The only permanent watercourse of the entire area is the Pecos River, which flows on its southward course by the town of Carlsbad, at this community's eastern edge.

As is customary, where mineral lands are worked under lease from the Federal Government, all operations are under the supervision of the Conservation Division of the U. S. Geological Survey. Frequent inspection at approximately weekly intervals is made by the Division's engineer.

Present capacity of the mine is somewhat more than 2,000 tons of crude potash ores per day. This tonnage is approximately as much as can be handled in the main shaft, through which all ore hoisting is done, with

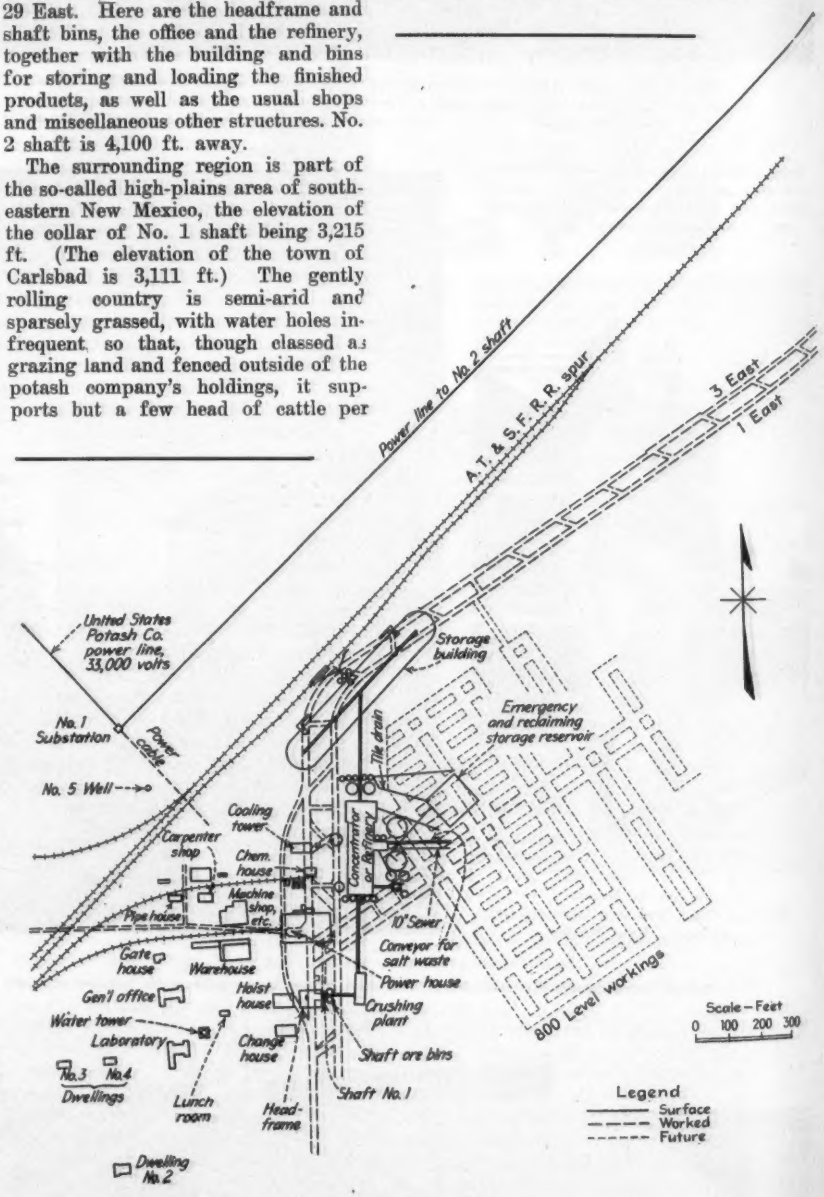
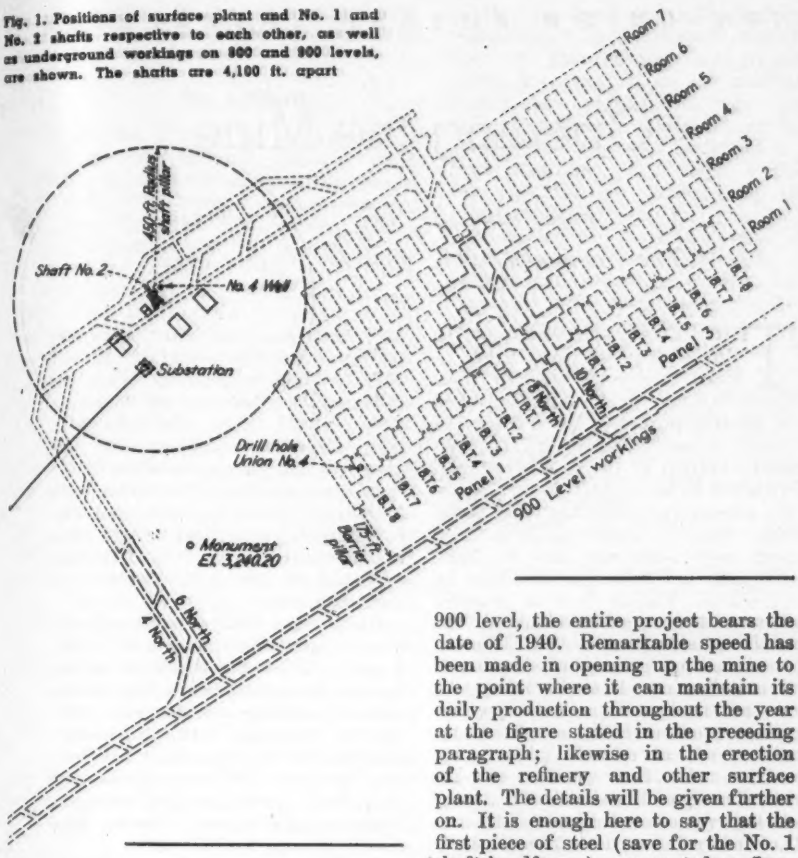


Fig. 1. Positions of surface plant and No. 1 and No. 2 shafts respective to each other, as well as underground workings on 800 and 900 levels, are shown. The shafts are 4,100 ft. apart



the present hoist facilities. Beginning in September and up until the end of January approximately 55,000 tons of langbeinite ore was hoisted for refinery use. Hoisting of sylvinite began in September, it being placed in the stockpile until the refinery was able to treat it. Since then approximately 104,000 tons has been sent to the refinery up to the end of January. Power supply is at present also a limiting factor. More could be used. Steel priorities, however, are holding up the shipment of an additional diesel unit now on order for the power plant. Mine and plant combined are credited with an ability to produce 80,000 tons of K_2O per year in the form of high-grade potash salts.

At present, while some construction and alteration work is still in progress, the company has approximately 475 men employed. Of these, 126 are on the mine payroll.

So recently was this project undertaken that at the end of January some minor construction work, as well as the general clean-up around the surface, was still in progress. Aside from the boring of prospect drill holes and the sinking of the main, or No. 1, shaft, which had been completed by the Union company on Jan. 15, 1940, together with a limited amount of development work immediately around the shaft in its bottom at the so-called 900 level, the entire project bears the date of 1940. Remarkable speed has been made in opening up the mine to the point where it can maintain its daily production throughout the year at the figure stated in the preceding paragraph; likewise in the erection of the refinery and other surface plant. The details will be given further on. It is enough here to say that the first piece of steel (save for the No. 1 shaft headframe) was erected on June 18 last. An approximate chronology of the progress made follows:

September, 1936. No. 1 shaft collared.

Nov. 1 (approximately), 1937. No. 1 shaft stopped at 300 ft.

Oct. 1, 1938. No. 1 shaft sinking resumed.

Jan. 15, 1940. No. 1 shaft sinking completed at 991 ft. 11 in.

April 1, 1940. No. 2 shaft collared.

June 1, 1940. Intensive underground development campaign begun.

June 18, 1940. First piece of steel of surface plant and refinery erected.

Oct. 1, 1940. First shipment, two cars of washed langbeinite.

Oct. 26, 1940. End of intensive underground development campaign.

Jan. 20, 1941. No. 2 shaft sinking temporarily stopped at 899 ft.

Drilling the Ground

Prospecting of the ground now held by the Union company, to the extent that it has been done, has consisted to date of the drilling of 22 holes put down by the company and its predecessors. These 22 holes are of varying depth and were spotted somewhat at random, although the results obtained in one hole would naturally suggest the positioning of subsequent ones. Of the 22, only the last 13 holes were put down by the Union company, the remaining nine having been bored by the companies previously on the ground. None of the test holes drilled in the district by the Federal Government are on the property.

Churn drills were used by the Union company in this work down to the salt, the holes being of 8 in. diameter. They were cased down to this point to seal off the water and were then continued below this point in 2¾ in. diameter by core drill, a brine being used as circulating fluid to avoid dissolving the core. Bits set with diamonds were used for coring. A double-core barrel was employed.

These holes are of an average depth of approximately 1,000 ft., being bottomed a little below the No. 4 bed. Underneath this bed some 25 ft. is a layer of red polyhalite which has served as a marker to indicate the point for stopping drilling. Some of the Government test holes that have been drilled in this region have gone entirely through the salt, a distance of 2,700 or 2,800 ft.

To prevent surface waters from entering the potash beds through the drill holes in times of possible heavy rainfall, rigid rules as to the condition in which they may be abandoned have been prescribed by the Geological Survey's Conservation Branch. A hole must be filled to the top of the salt with sludge and cuttings and a concrete plug inserted. The rest of the hole must then be filled with dry material and provided with a similar plug just below the water horizon and with a plug at the top and a section of pipe extending 4 ft. above the plug. The top of this pipe has a brass cap bearing the number and location.

The Local Geology

Two shafts, No. 1 and No. 2, are on the property. From them and from the boreholes put down has been learned what is known about the ore occurrences within the boundaries of the Union company's holdings. The sequence of formations exposed in No. 2 shaft may be taken as representative in general of the stratigraphy of the area. As described to the author, from the surface to 35 ft. below the collar there is an accumulation of sands and caliche of recent age. Near the bottom of this 35 ft. stretch are caliche and brown clay, with some gypsum, all of which may be Quaternary. Below this to the top of the salt at 407 ft. is the Rustler formation, Permian in age and comprising the Upper and Lower Rustler. Of the two the former extends from the 35-ft. depth to 215 ft., being mostly a massive gray gypsum with occasional layers of brown and gray clay. Immediately under this, the first 25 to 35 ft. of the Lower Rustler is known as the Rustler dolomite or limestone, which is water bearing and the source of the plant water supply. Between this and the salt at

407-ft. depth is brown clay and shale for the most part, with subordinate gray clay and gypsum.[9]

The top of the salt (Salado formation) is a sharp rolling contact, the roll being due to ground movement and possibly some solution of salt by seepage. Within the salt, and interlayed at frequent intervals with layers of brown clay are several thin beds of polyhalite with the four commercial beds known on the property. These are:

No. 1 bed, a mixture of sylvite and carnallite, expected at 655 ft. below the collar. (This bed is missing in the No. 1 shaft section.)

No. 2 bed, langbeinite, at 755 ft.

No. 3 bed, a mixture of sylvite and langbeinite, at 830 ft.

No. 4 bed, sylvite or sylvinite (the mixture of sylvite and halite) at 880 ft.

It is the No. 2 bed, of langbeinite, and the No. 4 bed, of sylvite, or sylvinite, that are being worked by the Union company, on the so-called 800 and 900 levels, respectively, of the mine. These are the only working levels in the mine.

A characteristic of the No. 4, or sylvinite, bed worked on the 900 level, is the presence in it of so-called salt markers, which are three horizontal seams of pink halite 6 to 12 in. in thickness, that occur at certain definite intervals between floor and roof. Experience in developing and working this level thus far indicates that these markers persist through ore and through waste. They are said to have proved useful in driving the headings.

When the present project was planned at the outset, it was estimated that there was sufficient sylvinite ore for at least 25 years of operation. The mining done in it thus far has been largely at the fringe of the ore.

As for the langbeinite, the reserve is ample. The No. 2 bed in which it occurs is thought to be the most persistent one on the Union property. At the same time, within the bed the langbeinite is said to be rather less continuous than the sylvinite is found to be in the No. 4 bed on entering the latter. Some salt, or halite, usually occurs with the langbeinite and at times a face may have so much of it that it may have to go for waste.

Although neither the No. 1 bed of carnallite ($KCl,MgCl_2,6H_2O$), nor the No. 3 bed, of langbeinite and sylvite mixed, is worked at present, they are considered to have possibilities for the future. With an outlet assured for its magnesium content, the carnallite would become interesting. As for No. 3 bed, the commercial separation of langbeinite and sylvite by selective flotation is already being forecast.

[9] Beds in the Rustler, particularly in Lower Rustler, are said to be fractured and appear to have slumped or settled. This may be due to solution and removal of salt beds originally interlayered in the Rustler formation itself or to solution of the upper part of the Salado formation after Rustler deposition according to G. T. Harley.

Opening the Mine

Two shafts cut the two beds worked. The room-and-pillar method is employed

THE TWO SHAFTS on the Union property are 4,100 ft. apart. From the start of operations to date, No. 1 shaft has served all hoisting purposes. No. 2 shaft was about to be connected with the 900 level workings at the time of writing. Adjacent to No. 1 shaft on surface are the refinery and shops and other buildings. Over its collar stands a four-post steel headframe, 120 ft. high, designed in 1940 and erected by Darbyshire Harvie Iron & Machine Co., of El Paso. Sinking of the shaft to its present depth was started in September, 1936, and completed in January, 1940. It was done with a 125-hp. small single-drum motor-driven Vulcan hoist, that was later transferred for sinking No. 2 shaft, where it has since remained. It was replaced at No. 1 shaft by the present double-drum Ottumwa hoist geared to a 250-hp. a.c. motor and winding a 1⅛-in. rope with a combination cage and skip counterbalanced in each hoisting compartment. The hoist has Lilly controls for overspeed and over-wind, with over-wind switches in the headframe.

Skip capacity depends on the ore. It has been recently increased by 0.5 ton approximately by lowering the false bottom built into each skip. This was done on Feb. 1 at the same time that the hoisting ropes were being changed. Before that the capacity was reckoned at 2.8 tons for sylvinite ore and 3.1 tons for langbeinite. Now it is taken at 3.6 tons for sylvinite and 3.90 for the langbeinite. The skips and cages were designed by the Union company and fabricated by Darbyshire Harvie of standard steel angles, plates, and screen.

The shaft has three compartments, each 5½ ft. wide by 5 ft. 8 in. inside the timbers, two of which serve for hoisting, the third being divided into a manway and pipeway. The latter is lagged with galvanized sheet steel and serves as a downcast airway for an Aerodyne fan at the collar, the hoisting compartments being upcast.

Timber sets of 8x8-in. timber, fireproofed, are used. They are spaced 5 ft. apart, center to center, with 2-in. fireproofed lagging as needed. The shaft is concreted down to and 25 ft. into the salt.

The shaft serves the present two working levels of the mine, known as the 800 and 900 levels, at 787 ft. and 902 ft. depth respectively below the collar. The stations are approximately 16x25 ft. in plan and 20 ft. high. They are equipped with telephones which are connected with the workings (and the surface), and with a Benjamin call-bell system and fire-extinguishing equipment. Shaft gates are provided 5 ft. high by 6 ft. wide and built of 2-in. pipe covered with 2-in. wire mesh.

All hoisting of ore, men, and supplies is being done at present in No. 1 shaft. Below the 900 level and extending to a point 90 ft. down is the primary crushing and automatic skip-loading equipment with the necessary pockets for the langbeinite ore from the 800 level and the sylvinite ore from the 900 level, the langbeinite ore being dropped down a 6x9-ft. raise that is close to No. 1 shaft.

Here below the 900 level, the primary crushing to 4-in. size is done before the ores enter the loading pockets. A Jeffrey single-roll crusher, 38x54 in. in size, is provided for the purpose. Separate hoppers for the langbeinite from the 800 level raise and the sylvinite from the 900-level rotary dump respectively are provided above the crusher. These can be made to deliver their respective ores by control from above as required on to a 5x25-ft. pan conveyor which passes under the chute openings of both bins and discharges to the crusher. The crushed langbeinite or sylvinite is then delivered by a hand-set deflecting chute to its respective 75-ton or 125-ton pocket below, each pocket having two chutes for the respective skip-ways. Manually operated arc gates control the flow from each of these chutes into a counterweighted revolving chute which dumps into the skip when the latter, as it reaches the bottom of the shaft, compels it to revolve. The revolving chute, of Link-Belt make, reaches the discharge position just as the skip comes to rest.

Up above on the 900 level at one end of the rotary dump is the push-button control for its operation and beside it the controller for operating the crusher and the apron conveyor that feeds it; and also an air valve for controlling the gate at the bottom of the langbeinite raise. Thus much of

the control of the crushing and loading operation can be exercised from this single point.

No. 2 Shaft

In No. 2 shaft the company has a completely fireproof opening, which has been sunk to improve the ventilation and to provide an additional exit from the mine. Collared on April 1 last year, it was 899 ft. deep at the end of January, work having been stopped temporarily ten days before. When it is placed in service it will be used for handling men and supplies for the 900 level, and No. 1 shaft will serve for hoisting all the ore, and in addition the men and the supplies for the 800 level.

No. 2 shaft is concreted through the loose surface material and the Upper and Lower Rustler formations for a distance of 407 ft. and 23 ft. below the last into the salt. At a depth of 425 ft. is a small pump station to catch any water that might work down to the salt. Below the concrete the shaft has been left untimbered. The bare salt walls are to be sprayed with water or possibly brine to produce a surface glaze that will prevent sloughing. Some clay streaks in the walls will be gunited.

No. 2 shaft has two hoisting compartments, each 5x7 ft. in the clear with an 8x7-ft. manway having subway-grating landings at intervals of 15 ft. Its cross-sectional area, unobstructed, is approximately equal to that of the entries underground, which are 16x8 ft. at the smallest. Guides are carried on two steel H-beams 8x8 in. in dimension, serving as dividers. Over the shaft stands a steel headframe 60 ft. high erected last year for the company by the Patterson Steel Co.

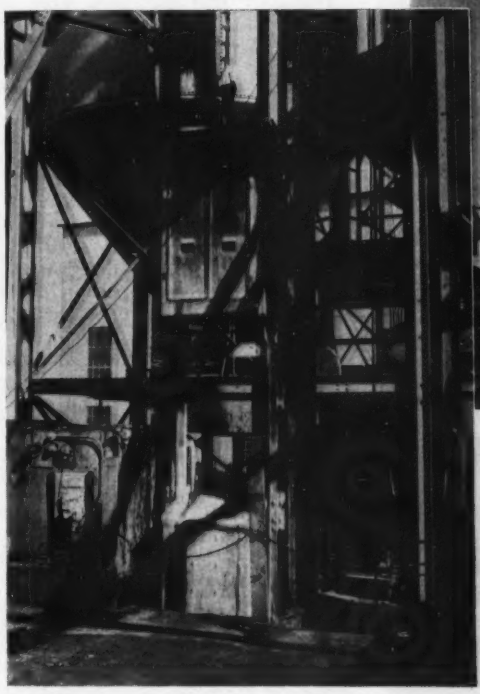
In sinking No. 2 shaft, no effort to attain speed was made, there being no underground workings at the time (nor yet) with which connection had to be made. The men enjoyed a bonus scheme of pay during the sinking period. On each of the three shifts there was a nine-man crew consisting of one shift boss, five miners, two top landers, and a hoistman. The six men in the shaft did all the work, including breaking, mucking, timbering, and pouring of concrete.

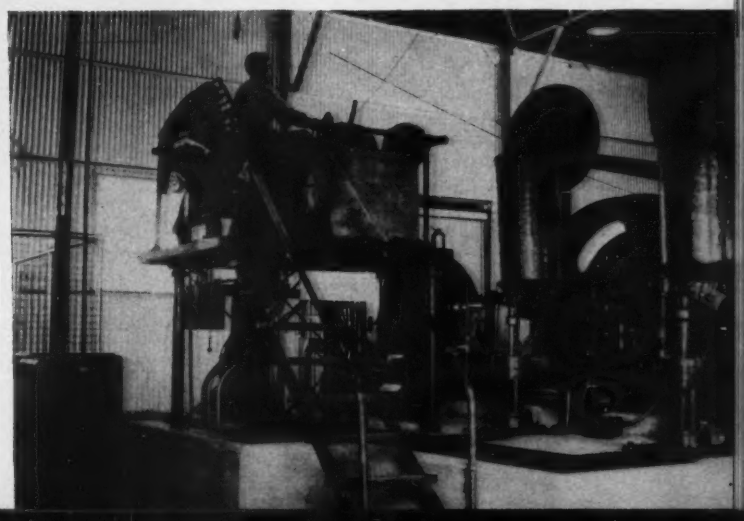
In general, the practice in sinking through the concreted zone was to keep the bottom a safe distance, about 25 or 30 ft., below the last timber set. After each round was blasted and mucked another set of timbers was placed below the last. When four such sets, there being four to 20 ft., had been put in position below the stretch previously concreted, they would be lagged on the inside, and the space between the last set and the walls of the shaft would be closed with planks nailed to the bottom of the set to serve as a footing for the concrete. After the reinforcing rods and hoops had been set in position, the concrete was lowered in a bucket and poured from the bottom set up, the bottom of the previously poured concrete above being first chipped off on the slant at its lower end all around the walls to furnish a fresh bonding surface.

To insure a firm bond between the concrete lining and the walls, either

Headframe and ore bins at No. 1 shaft. The steel structure is 120 ft. high. Thus far it has served for handling all ore, men, and supplies

At the collar of No. 1 shaft. Cage and skip descending





No. 1 shaft hoist, here seen, has two drums and is driven by a 250-hp. motor. It handles a combination cage and skip counterbalanced in each hoisting compartment

This 60-ft. steel headframe stands over No. 2 shaft

anchor pins, made of short lengths of reinforcing steel, were used, the pins being driven into the walls at 45 deg. and the concrete poured around them, or hitches were cut in the wall at intervals and allowed to fill with concrete as it was poured, the reinforcing first being carried around into these recesses.

The Mining Method

Aside from the sinking of No. 1 shaft, it was not until the spring of 1940 that development and construction work was really begun with the definite purpose of opening a mine on the Union Potash holdings to exploit the commercial beds disclosed by drilling and to erect a plant or refinery for treating the crude potash salts produced. Once entered upon, both the underground development campaign and the plant construction proceeded at a remarkably rapid rate.

Up to this time there was no opening on the ground, aside from the drill holes and No. 1 shaft, which had been completed to its present depth of 992 ft. soon after the turn of the year. The location of this shaft is shown on the accompanying map in Fig. 1. As previously stated, all ore produced has been moved through it, as well as men and supplies. Its site had been chosen originally because it was thought that a shaft here would intersect both the langbeinite or No. 2 bed and the sylvinite or No. 4 bed. Both beds had been found, but in the case of the sylvinite the shaft proved to be in a salt roll at this point, as predicted from the test drillings. Stations had been cut at the 800 and 900 levels respectively, and driving of entries begun on Sept. 28 in the case of the 800 level and on June 1 on the 900. Between Jan. 15, 1940, and May 1, 1940, 600 ft. advance had been made on the 900 level and 150 ft. on the 800 level.

For the exploration of both the No. 2, or langbeinite, bed and the No. 4, or sylvinite, bed the room-and-pillar system of mining was selected. Conditions for this method are ideal. Save for minor undulations affecting track grades at times in the case of No. 4, each bed is nearly horizontal, with a slope of 2½ percent to the southeast. Both ores are easy to undercut and drill. The langbeinite is brittle and in contrast the sylvinite is rather compressible. Timbering is not required and water is absent, although bodies of it are known to occur in the district in the Rustler dolomite, which in the Union mine is some 160 to 170 ft. above the salt. Some gas, mostly nitrogen, has been encountered in the district, and in these workings some nitrogen gas was encountered on the 850 level at No. 1 shaft. In any case, excellent ventilation can easily be maintained. In addition, the mining horizon is at relatively shallow depth.

About each shaft has been left a shaft pillar of 450-ft. radius. The ground has been opened by driving parallel entries connected at intervals by breakthroughs, as commonly done in coal mining. The mining areas are divided into panels, separated from the main haulage by 225- and 175-ft. barrier pillars, and served in pairs by parallel connected entries turned off from the main haulage. The manner in which mining has been done within the panels is shown to scale in the accompanying maps of the workings, (Fig. 1; also Fig. 2 on p. 52), and Fig. 6 on p. 58 to which the reader is referred.

Pillars on the 800 level are 32x136 ft. in dimensions between rooms and 24x96 ft. between breakthroughs. Percentage of extraction will be 64 when the system is fully developed. However, more ground is being left in place, on account of salt, than the map indicates—probably 20 percent more.

G. T. Harley, general superintendent

John P. Burrows, purchasing agent and assistant to the manager

On the 900 level, pillars between panel entries are 48 ft. wide. Between panel entry and first breakthrough they are 58 ft. wide when panel entries are 24 ft. wide, and 50 ft. wide when panel entries are 32 ft. wide. The regular size of pillars in rooms is 40x80 ft. Extraction within the panel is 60 percent, and this is usually reached in the course of mining operations on this level.

The work that has been done on each of these levels has features of special interest. Operations on both levels have been planned from the start for undercutting, drilling, and mechanical loading. The 800 level has been equipped with rubber-tired shuttle cars operated under a trackless trolley system in the main haulage entry between the working area and the shaft. A cable reel on the cars permits them to operate in the rooms. Air drills have been used for drilling on this level where the ore is langbeinite, which is materially harder than the sylvinite.

In contrast, the 900 level has been equipped for standard trolley haulage using electric locomotives and cars, a combination cable-reel locomotive and a storage-battery locomotive serving the workings off the main line. Electric post drills with auger bits are used in the ore, which is sylvinite, in conjunction with the undercutting.

The 900 level, moreover, has been the scene of an intensive development campaign, in the course of which some remarkable work in rapid driving was done. Inasmuch as this involved the major effort that had to be made to bring the mine into production by the time the refinery was ready for treating the ore, the story of the intensive campaign will be related first.

An Intensive Development Campaign

Entries driven rapidly into the 900 level sylvinite ore zone, bringing the mine into production with minimum delay

BY MAY 1 the development entries[10] on the 900 level, started due north, as Fig. 1 shows, had been advanced 600 ft. Here the work was stopped temporarily to await the installation of a rotary dump at the shaft and the shaft skips, as well as the arrival of other mechanical equipment, such as a Joy loader, undercutting machines, electric drills, and haulage equipment.

Driving was subsequently renewed with the new mechanical equipment on June 1, a date marking the beginning of an intensive development campaign that was to continue until the ore zone was reached that fall. A Goodman Type 512 short-wall mining machine, or undercutter, was employed in one entry[10] and a Sullivan Type 7B undercutter in the other. Each was equipped with a 9-ft. cutter bar, having a standard chain with Super-Ceseo bits. Each was powered with a 50-hp. motor. These machines are not mobile but have to be hauled from face to face on trucks provided for the purpose. The undercutter first pulls itself upon the truck over a tilting slide that is part of the truck. Then on the truck it is taken to the next point of use, the truck being moved either by a locomotive or by the machine itself, which gets its power through a trailing cable.

For those engaged in metal and other mining who are unfamiliar with the operation of undercutting it may be said that both types of undercutting machines used by the Union company are equipped with a cutter bar 9 ft. long that carries an endless traveling chain having cutting bits inserted at short intervals. The chain's vertical dimension is great enough to permit the bits to be spaced up and down also so that any given bit does not cut in the same path as the bit that immediately precedes it but higher up or lower down, with the result that a cut can be made several times as high as a single moving bit could cut. The chain, when actuated by the 50-hp. motor, travels the length of the bar at a speed of about 450 ft. per minute, around a sheave at the end and back the other side of the bar and thus endlessly.

The operation in undercutting the face in an entry heading is begun in the right-hand corner. The undercutter starting in the corner at a varying angle to the side is so manipulated that the initial cut is made by the bar along the right rib in line with the right side of the heading, the machine being gradually swung around until the bar is pointing straight ahead parallel with the direction of the heading and has cut into the face as far as it can go, which is about 8 ft. with a 9-ft. bar. The initial cut thus made is about 2 ft. wide and 5 to 5½ in. high above the floor of the heading. This operation is known as "sumping in." Without further change in direction, the machine and bar are now moved laterally toward the left rib, undercutting the rest of the face. When this is done the face is completely undercut for its full width to a depth of 8 to 8½ ft., the cut being 5 in. or a little more in height. With either undercutter the cutting speed of the machine laterally from one side of the heading to the other, once it is sumped in, is about 6½ in. per minute.

The manipulation of the machine, whereby it is made to move first in a curved path gradually into line with the heading in sumping in and then laterally across the face, is accomplished with the aid of wire ropes which are paid out from the machine (or wound in as desired) by drums embodied in its design and which ropes are pinned respectively to the left and right corners of the face at the bottom. An eye in the rope end is slipped over a steel pin which is set in the corner in a hole drilled with a small portable electric drill at the outset of the work.

In making the cut or "kerf," a volume of material equal to the width of the face multiplied by the 8-ft. depth of cut and the 5 to 5½ in. height is reduced to fine cuttings, part of which are ejected behind the machine by the conveying action of the cutter chain and bits and are shoveled away as fast as produced by the machine operator's helper. These cuttings are commonly known as "bug dust." About an inch of bug dust remains in the kerf.

In "sumping in," the undercutting machine may start in two ways: one, almost parallel with the face in the right corner. Thus it will have to make almost a 90-deg. turn before getting sumped in with the cutter bar pointing straight ahead in the direction of the heading. Or else it may start more nearly parallel with the side or rib and sump in with the cutter bar, making its initial cut into the ground almost end on.

When the cut is completed across the face, the face is ready to be drilled. The drilling may be started at the left of the face, if desired, while the undercutting machine is be-

Rotary dump, of Link-Belt make, at No. 1 shaft on 900 level. It handles one car at a time, being operated by the pushbutton control at the left

[10] The reader, accustomed to metal mining terminology, will encounter in the text various terms commonly used by the coal miner. The room-and-pillar system, here to be dealt with, with its panels and entries and such operations as undercutting, is one rarely used outside of coal mines.

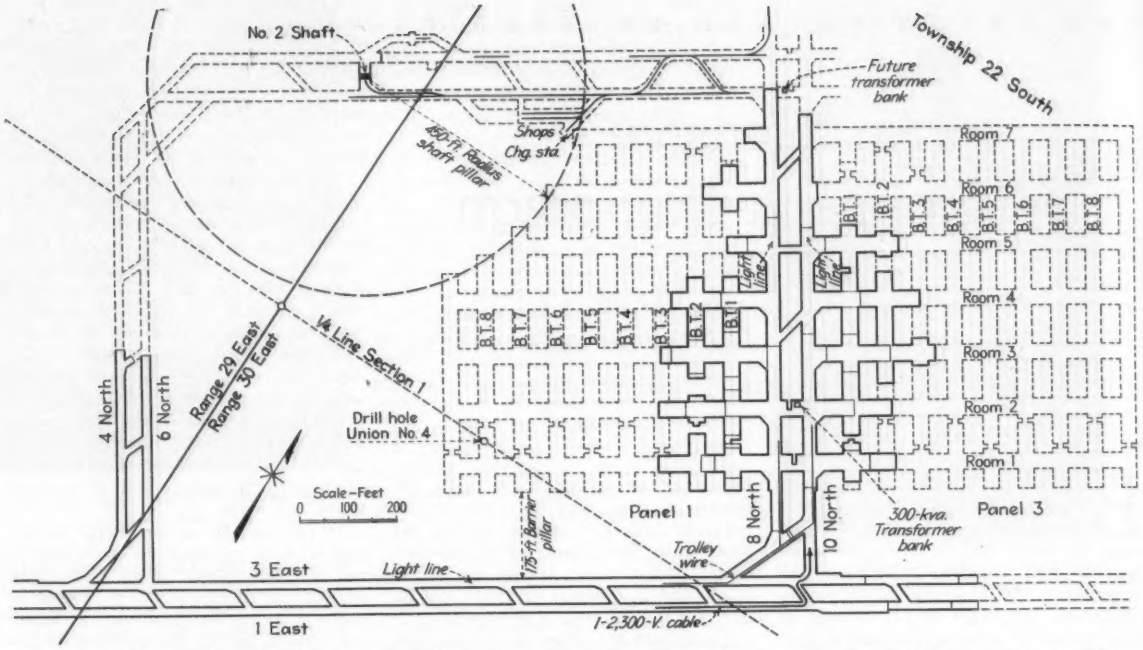


Fig. 2. . . . Map of the mining area on the 900 level as opened up from No. 1 shaft by early February. Since then the panel entries, 8 North and 10 North, have been driven ahead and turned to make connection with No. 2 shaft

ing "sumped in" at the right, the drilling progressing to the right as the mining machine travels to the left. This was the procedure adopted during the period of intensive development. Now, however, the drilling follows the undercutting, especially where there is a sufficient number of faces to permit alternating from one to another.

All drilling in the development campaign in the 900 level was done with Jeffrey Type A-6 electric post drills and auger steel equipped with McLaughlin bits. The bits were purchased in two sizes, namely a $1\frac{7}{8}$-in. starter and a $1\frac{3}{4}$-in. second bit. Smaller gages were obtained by sorting reground bits.

The drill round used in the headings is shown in Fig. 3. As drawn, it is intended for an entry 16 ft. wide as originally planned. However, a 15-ft. width was found sufficient where but a single track was used. An undercutting machine was kept in each heading and was pulled straight back when not in use. The 15-ft. width was sufficient to accommodate this and a Watt car $5\frac{1}{2}$ ft. wide with sufficient clearance between the equipment and the ribs. When, however, the entry had to be double-tracked, a 17-ft. width was used to accommodate two $5\frac{1}{2}$-ft. (wide) cars with 2 ft. between them and 2 ft. on each side between car and rib. In any case the holes were spaced 4 ft. apart.

The set-up used for the electric drills is shown in sketch in Fig. 4.

Faces were lighted with 110 v. 60-watt Mazda lamps carried to within 50 ft. or closer.

The drillers did their own loading and blasting, using 45 percent Du Pont Gelex No. 2 powder, with electric delays. Shooting was done with two blasting wires and a blasting switch from the nearest breakthrough, using 220-v. current taken from the line through a switch that was normally locked open, the key being kept by the shift boss.

Except in the month of June, throughout the development campaign there was one powder man (or blaster) on each of the three shifts. He was kept busy, especially as the driving speeded up. As the pace quickened he might shoot as many as three rounds of 15 holes per shift in each of the two entry headings (not considering the breakthrough at intervals), or 90 holes per 8-hr. shift.

The manner of using the delays is indicated in the drawing of the round in Fig. 3. No. 1 delays (Du Pont) were used in the three bottom holes inside the rib holes; No. 2 delays in the bottom rib holes and the three inside holes of the second horizontal row; No. 3 delays in the two rib holes of the second row and the three inside holes of the top row. The two top rib holes were shot with No. 4 delays. In general the rib holes are always loaded to lag behind the other holes in the same row by using the next higher delay. This allows them to shoot down and out.

Powder was loaded usually ten sticks to the hole, there being 150 8x$1\frac{1}{8}$-in. sticks to the 50-lb. case. Where the ground proved tougher than usual, there might be some variation, such as using nine sticks on the inside holes with eleven or twelve in the corner holes at the top. Stemming was used at times. Empty cartridge cases were bought for this purpose and filled with clay on the surface by being stood on end, a box full at a time, and loaded. Consumption of explosives was 6 lb. of powder per foot of advance.

The amount of waste (salt) produced in driving the development entries by thus undercutting, drilling, and blasting was 68 tons per round. As will be seen further on, up to 19 rounds were blasted in 24 hours by the time this development campaign had reached its peak, yielding approximately 1,300 tons of waste.

The broken waste or muck from the two headings and from the breakthrough where one was being driven was loaded by a Joy Type 11 BU loader into 6-ton (5.2 tons of sylvinite) Watt rigid-body steel cars of 32-in. over-all height. Under conditions of maximum tonnage this loader has averaged 83 cars or 433 tons of salt per shift. The cars were serviced behind the loader with a 6-ton Westinghouse storage-battery locomotive. The main-line locomotive during the development campaign was an 8-ton combination trolley and cable-reel unit of the same make. Further data regarding this haulage system are given on p. 57.

At first 40-lb. rail was used, which was replaced as fast as possible with 60-lb. An effort was made to carry the heavier rail up to the face of the main entry, but it usually failed to accomplish this by 300 or 400 ft. For one thing, there was insufficient 60-lb.

rail and, in addition, the driving proceeded so fast that the time available did not permit the careful work desirable in laying the heavy rail, so the lighter rail was used instead. However, in passing from 40-lb. to 60-lb. rail a so-called compromise joint was (and is) used, consisting of a piece of each weight of rail butt-welded end to end with the crowns flush on the inner side, the whole being about 5 ft. long. In passing from a breakthrough to the back entry a 40-lb. switch was employed. The cars were hauled in trains to the shaft and dumped one at a time by means of the rotary dump, a Link-Belt unit with pushbutton control.

The crew that drove the entries ahead consisted of a shift boss on each shift with nine men, comprising one undercutter operator and his helper, three drillers, one Joy loader operator and a helper, one motorman for the gathering locomotive, and a nipper for switching cars and working around the back end of the loading machine.

In addition to these nine there were nine more, giving a total crew of 18 men per shift chargeable to development during the period before ore extraction started. The nine comprised a repairman, a powderman, two trackmen, a station tender, a mucker, the hoistman, and two top men. In fact these 18 men per shift constituted the total mining payroll, not counting the crew of electricians who installed trolley lines, power cables, lighting and blasting wires, also bonding rails and servicing and maintaining the various electrical equipment. The electricians also put in the wire to support the Ventube for the auxiliary fans and, at intervals, extended the primary cable through the back entry and tried to keep the portable transformers not more than 500 ft. from the face.

Thus the work of driving the entries and the connecting breakthroughs was conducted throughout the development campaign.

Soon after this campaign was begun on June 1, the main haulage entries which had been driven as 1N and 2N from shaft No. 1 were turned at a distance of 820 ft. from the shaft

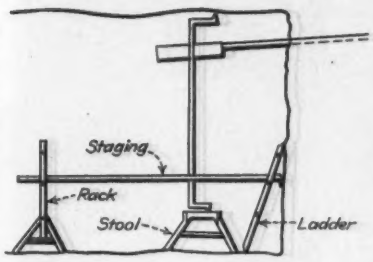


Fig. 4. . . . Illustrating the manner of setting up one of the electric drills for drilling the sylvinite. Staging includes stool, rack, and ladder shown, with a 3x12-in. plank, 11 ft. long, of oak or No. 1 pine

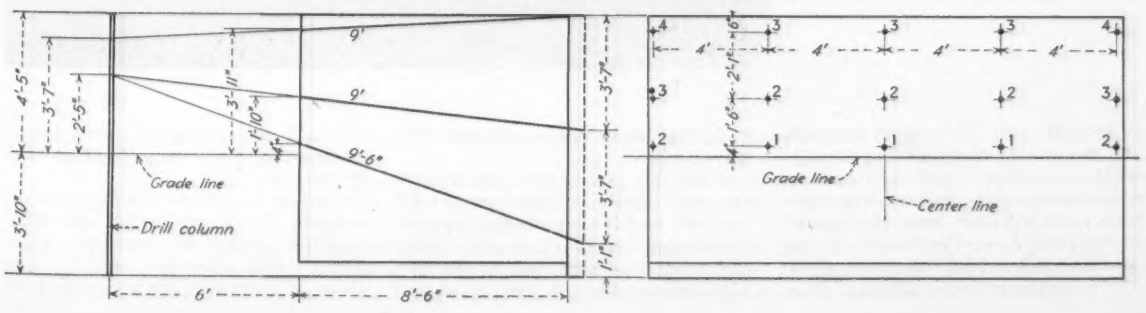
so as to run 56 deg. 04 min. E. from the northerly direction toward the sylvinite area, which was known to lie a few thousand feet to the east, though having boundaries that were but vaguely known. This direction of N. 56 deg. 04 min. East was selected so that these two main haulage entries would skirt the south edge of the orebody (as determined from a contour map of No. 4 bed, plotted from test holes, and from a map showing the assumed outline of the orebody), and be approximately parallel to its contours, thereby permitting the haulage within the orebody to be on a grade favorable to the load, the reason for this being as follows: While the No. 4, or sylvinite, bed that is being worked on the 900 level is in general horizontal, the area in panels 1 and 3 (see Figs. 1 and 2) slopes slightly toward the southeast, so that entries 8N and 10N, which have opened these panels and which are turned off at 90 deg. from the main haulage, can be given a moderately favorable grade.

In their new direction the main haulage entries were known as 3 East (the main entry) and 1 East (the back entry). They were carried 53 ft. center-to-center, each being 15 ft. wide in the waste and 8 ft. high. Breakthroughs, 15x8 ft. in cross-section and 48 ft. long, were driven at intervals of 150 ft. at first. This interval was finally lengthened to 180 ft. because the ventilation was found to be good. It is a multiple of the rail length, which is 30 ft.

Meanwhile, sinking was under way at the new shaft, No. 2, which had been collared on April 1 to the northwest of the panel area at the site shown in Figs. 1 and 2. It was intended to serve as part of the ventilation scheme and to provide another exit from the mine for reasons of safety. Its site was selected on the supposition that the shaft would be in waste (salt, or halite) on the edge of the sylvinite area already mentioned. However, it proved to be in the sylvinite, though probably on its edge.

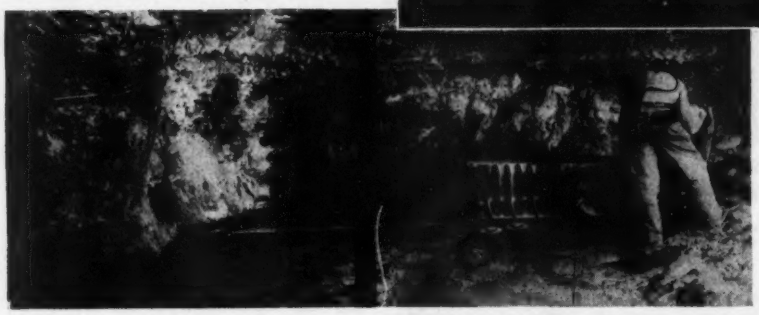
On entering the ore the haulage entries 3E and 1E were widened to 20 ft., at which width they have since been carried. As their driving progressed, entries 4N and 6N, also 20 ft. wide, were turned off at 90 deg. to the left in the direction of the ground about No. 2 shaft with the idea of making an early connection, the headings of 3E and 1E at the same time being continued toward the sylvinite. On Oct. 26 4N and 6N entries had reached a point 450 ft. from the main haulage entry (3E) and the headings of 3E and 1E entries, now in the sylvinite for some 350 ft., were 5,000 ft. from shaft No. 1. As the date for starting the refinery was approaching, the driving of the entries 4N and 6N was stopped and work was concentrated on driving the 3E and 1E headings as rapidly as possible into the ground from which the immediate production was to come. As soon as 3E and 1E were abreast of what was laid out on the map as panels 1 and 3, panel entries 8N and 10N were turned off in the sylvinite area, every effort being made to get the curves in and some rooms necked so as to permit starting production. In the meantime, some output had been coming from the development work in the sylvinite, and this, together with the now steadily increasing production from the newly opened panels 1 and 3, sufficed for the requirements of the refinery when the sylvinite section was started, in mid-October, and thereafter. (The langbeinite section of the mill was started on Oct. 1.)

Fig. 3. . . . Round used with electric drills in driving entries on 900 level before they entered the sylvinite ore zone. The face was undercut as shown



Electric drills, of Jeffrey make, post-mounted and using auger steel with McLaughlin bits, in 24x10-ft. heading of 8N entry in Panel 1. Compare staging with sketch in Fig. 4 on preceding page. A third driller, in the right corner of the heading, is out of the picture. The underground pictures shown here and elsewhere in this issue were taken by Ray V. Davis, Carlsbad

Goodman shortwall mining machine, or undercutter, in face of Room 1, Panel 3, 900 level. Note accompanying pictures



Another view of Goodman undercutter, showing the cutter bar, in shaft runaround of 3N entry. Since this picture was taken, pins, as described in text, have been adopted for anchoring the feed and tail ropes in place of jackposts such as that seen in foreground

Joy loader in heading of 1E entry, about to start loading one of the 6-cu.ft. steel mine cars used on 900 level

The date Oct. 26 is given as marking the end of the intensive development campaign that had started almost five months before. The headings, already in ore, were by this time being carried at the height of the sylvinite bed, which was as much as 11 ft. and even more, instead of at 8 ft. as when driving through the barren salt.

Since the date given, development has been limited to panel entries 8N and 10N and the breakthroughs, these nevertheless, at the time of writing, still being driven as fast as possible, with the purpose of getting abreast of No. 2 shaft, at which point a connection will be driven southwestward to meet it.

Further to aid in making this connection, panel entries 8N and 10N have been driven at a narrower width than would otherwise be the case. Once in the mining or panel area all

Six-ton storage-battery locomotive, of Westinghouse make, serving cars to Joy loader in 5E entry which has been turned off from 8N panel entry to connect with No. 2 shaft

Another view of Goodman undercutter

Sullivan 52-in. scraper-slide loading cars in a breakthrough in Panel 1. It comprises a three-drum hoist operated by a 30-hp. motor and a 46-in. box-type scraper or "dipper"

An 8-ton combination trolley and cable-reel locomotive of Westinghouse make with three loaded cars. In the background across the entry is a cloth brattice for control of ventilation

Main-line haulage on the 900 level. A trip of loaded cars with a 13-ton Westinghouse trolley locomotive just north of No. 1 shaft, approximately a mile from the mining area

headings, whether entries, rooms or breakthroughs, are supposed to be carried 32 ft. wide and the height of the sylvinite bed. However, panel entries 8N and 10N, after being driven through the 175-ft. barrier pillar, as shown in Fig. 2, at the 20 ft. width at which they were turned off from the 3E haulage entry, were widened to only 24 ft., instead of 32 ft., as a compromise to permit greater speed in driving and were thereafter carried at this width.

In these wider higher headings, the drill holes are still spaced 4 ft. apart. The number of horizontal rows of holes is 3, 4, or 5, depending on the height of the heading.

This speed in driving the panel entries resulted in the mining system being somewhat overextended at the time of writing, scarcely a room or breakthrough being finished despite the extent of the mining area.

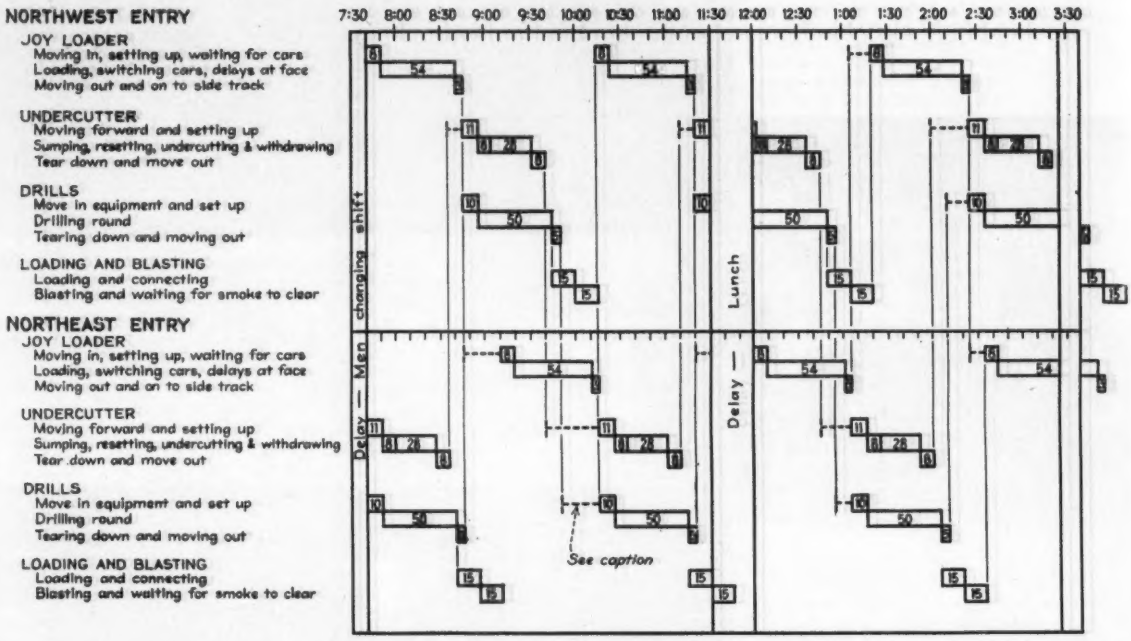

NORTHWEST ENTRY
JOY LOADER
Moving in, setting up, waiting for cars
Loading, switching cars, delays at face
Moving out and on to side track
UNDERCUTTER
Moving forward and setting up
Sumping, resetting, undercutting & withdrawing
Tear down and move out
DRILLS
Move in equipment and set up
Drilling round
Tearing down and moving out
LOADING AND BLASTING
Loading and connecting
Blasting and waiting for smoke to clear
NORTHEAST ENTRY
JOY LOADER
Moving in, setting up, waiting for cars
Loading, switching cars, delays at face
Moving out and on to side track
UNDERCUTTER
Moving forward and setting up
Sumping, resetting, undercutting & withdrawing
Tear down and move out
DRILLS
Move in equipment and set up
Drilling round
Tearing down and moving out
LOADING AND BLASTING
Loading and connecting
Blasting and waiting for smoke to clear
7:30 8:00 8:30 9:00 9:30 10:00 10:30 11:00 11:30 12:00 12:30 1:00 1:30 2:00 2:30 3:00 3:30
Men changing shift
Lunch
Delay — Men
Delay —
See caption

Fig. 5. . . . Summary of time studies made by G. T. Harley, of the operations of undercutting, drilling, loading, and blasting in driving Northeast (or 1E) and Northwest (or 3E) entries on 900 level during development campaign. The spaces represented by broken lines mark time when the operation was idle, due to differences in time required to complete each operation. During these periods, inspection, repairs, oiling, changing bits, eating lunch, and other activities were being done

The Speed Achieved in the Campaign

This recital of the successive steps in the development campaign on the 900 level gives little idea of the actual speed achieved in driving. The campaign was started, as stated, on June 1, using the new mechanical equipment. For the first week the daily average advance for the three shifts combined, totaling that scored in the two headings of the main and back entries respectively, plus that made in any breakthrough between the entries, was 42.3 ft., and in the second week it was about the same, 42.7 ft. The third week the daily average rose to 55.1 ft. Thereafter the daily average rose rapidly though not with perfect uniformity. On June 29 it was 62 ft., dropping to 42 ft. on June 30 but rising to 73 and 92 ft. respectively on July 1 and 2.

On July 15 the development work was put on a bonus basis and on that date the daily average advance rose sharply, being 109 ft. Thereafter it continued to increase. On Aug. 1, it reached 120 ft. Aug. 15 saw it at 150 ft., almost but not quite the record for the campaign, which was 153.3 ft., achieved on Sept. 18. On that date 19.15 8-ft. rounds were drilled, blasted, and loaded out in 24 hr. A round was undercut, drilled, and blasted in 70 min., while the loading crew was mucking out the other heading in the same time. On the four days following the average declined to 124, 123, 91, and 76 ft. respectively, as the height of the two entries increased and other conditions changed as the headings entered the ore zone.

To summarize the results achieved in this development campaign, an almost perfect work cycle was developed based on the longest time of any one operation, which was loading. With 9 men actually at the face per shift or 27 men per 24 hr., 70 tons was broken and moved per round continuously. From 15 to 19 rounds were broken per 24 hr., this giving 75 min. per round for 19 rounds.

Time studies of the component operations of the work cycle were made by Mr. Harley early in the development campaign. The results of these studies have been summarized by him in an interesting graph which is reproduced in Fig. 5. The operations analyzed are those of (1) undercutting; (2) drilling; (3) loading the holes and blasting; and (4) loading the blasted waste with the Joy loader. Such studies were made in two adjacent headings where the same crews and equipment were engaged, alternating from one to another. The results are plotted from left to right.

This summary represents the best practice developed up to the inauguration of the bonus on July 15. After the bonus was started, the men cut out the regular lunch period, each group eating as they found time, so that the operations shown in Fig. 5 after 3:30 p.m. were brought into the limits of the 8-hr. shift, thus completing 6 rounds in 8 hr., or 18 rounds in 24 hr. on the theoretical possible (144 ft.).

Mining on the 900 Level After the Campaign

With the completion of the development campaign and the opening of the mining area on the 900 level, operations entered upon a new phase. In part this has already been pointed out on page 55, with stress on the fact that in the mining panels all headings are carried 32 ft. wide except where this has been modified to gain speed in the driving of the 8N and 10N entries and that even these are being driven 24 ft. wide. While this affects the cycle of the mining operation so that it will differ from that illustrated by the development time-study graph in Fig. 5, it leaves the technique followed in undercutting, drilling, blasting, and mucking largely as it was during the development period. Faces are wider and higher than before, a bigger footage has to be undercut, more holes have to be drilled and loaded, more delays used, and the tonnage to be mucked with each round is larger. But the procedure is as described for development. The time consumed for the individual operation is quite changed. Here this cannot be shown with specific illustration, inasmuch as the operating pace has been so rapid, even since the development campaign was concluded, that the staff as yet has had no time for making further time studies. It must suffice here to consider how the mining operation offers the opportunity to achieve greater efficiency than does the development operation.

The individual operations offer examples: A 32-ft. face has approximately twice the footage of the 15-ft. or 17-ft. face used in development in waste, but moving in and sumping in have to be done but once. Moreover, in subsequent drilling, the drills, once moved into the 32-ft. face, can drill approximately twice to three times as many holes as before. Similarly with loading for blasting, though to a minor extent. Likewise in mucking, the loading machine has twice to three times the tonnage of muck to work on in the 32-ft. face with only one operation of moving, this depending on the height of the face, which varies from 8 to 12 ft.

Advantage is also gained in mining, as compared with development, from the fact that as soon as a room heading reaches the point where a breakthrough is to be turned off to the right and to the left, three faces immediately adjacent to each other become available for all operations, reducing to a minimum the amount of moving of men and equipment required. This advantage lessens somewhat as the faces progress away from each other, but is repeated each time the point for a breakthrough is reached, which is rather frequent in panels 1 and 3 on the 900 level, where the pillars are 40x80 ft. in dimensions. In any case no comparable advantage is had in the course of driving development headings, as pointed out by Mr. Morris.

Performance in undercutting is good and, it is thought, can be improved. As in the development campaign, a 9-ft. bar is used, undercutting to as much as 8½ ft., and this breaking 8 to 8½ ft. on being drilled.

In drilling the sylvinite ore, which is done with the electric drills, holes are spaced 4 ft. apart and in general are drilled according to the round shown in Fig. 3. However, the number of horizontal rows varies from three to five with the height of face. The bottom row is collared about breast high and pitched down so as to end 6 in. beyond the end of the undercutter kerf and 6 in. above it. No attempt is made to square the face by means of moiling before drilling is begun.

Under conditions of maximum tonnage the Joy loader loaded 80 cars per shift on the average, or 416 tons per shift at 5.2 tons per car. This machine is capable of cleaning up the face save for approximately 2 tons of muck which has to be placed by hand upon the loader as the final step in mucking out.

The men working at the face do all their own work. For example, the Joy operator and his helper take the machine into the face, set it up and load out the round, clean up the face (ready for the undercutter or drilling crew to set up), and move to a new face. Likewise the drillers, undercutter men, and scraper operators. In a concentrated mining system it is therefore necessary that the working places be maintained very close to each other. At present this is not possible at the mine, as it is necessary to do excessive development work at long distances from the place of main economic production. As soon as development work has been caught up, all operating figures will show improvement, it is expected.

After the development campaign was ended, a Sullivan scraper-slide was put into service on the 900 level in addition to the Joy machine. It comprises a Class BF312 Sullivan three-drum hoist with a box-type scraper, or dipper, of 1-ton capacity. It is operated with a 35-hp. motor and rolls on the 42-in.-gage mine track, being provided with clamps for holding fast to the rails whenever it has work to do. Being mounted on a turntable, it can swing in any direction. Its pull rope is ⅝ in. in diameter and the two tail ropes are of ½ in. diameter. It uses two sheaves or blocks, one in each corner of the face where the sheave is attached to a steel-wedged eyebolt. The holes for these bolts and their wedges are put in by a hand-held electric auger drill taking 110 v., a.c. An advantage of this loading unit is that it can move the muck nearer itself and pile it up while waiting for cars. The heading is lighted with a 200-watt lamp from the mid-point of the roof.

Blasting and Haulage on the 900 Level

Separate magazines for both the Gelex No. 2 powder used and the electric delay primers are provided along the 3E entry on both levels some distance from No. 1 shaft. Here the powder man makes up his primers, taking them in specially constructed hand cases and the powder in a special powder car to the headings, where they load the holes and blast, shooting usually at the end of the shift. During development on the 900 level shooting might be done as often as six or seven times a shift. Now that there are several working faces, the powder man will load a face and connect the leg wires, and at the end of the shift, or at lunch time, just have to connect his blasting line to the connecting wire. The preparation and handling of explosives and the blasting operation are discussed in more detail in connection with the 800 level operations.

Haulage on the 900 level is accomplished with a 250-v. d.c. trolley installation, supplemented by cable-reel attachment on one of the locomotives and by a storage-battery unit for gathering. The direct current is supplied by a Westinghouse motor-generator set having a 250-hp. synchronous 2,300-v. motor and a 150-kw. generator, placed in a breakthrough near the shaft. The overhead wire used is 6/0 grooved on the main line and 4/0 grooved on the secondary lines. Return is through the bonded rails.

Three locomotives are now provided, the 8-ton combination trolley-and-cable-reel unit and 6-ton storage-battery unit used during development having since been supplemented by a 13-ton trolley locomotive for main-line work. All are of Westinghouse make. To provide current for charging the storage battery a separate motor-generator set is installed consisting of a Westinghouse d.c. generator and a 40-hp. induction motor.

The track is of 60-lb. rail on the main line and 40-lb. rail elsewhere and of 42-in. gage. It is carried on 5x7-in. ties, 6 ft. long, of local timber, which are laid directly on the solid or with such ballast as the grade requires. A limited supply of steel mine ties is available for use in the headings. They are occasionally used as spacers between the rails. When the main entry was driven during the development period, an effort was made to keep to grade and at the same time follow the salt markers. The result was a compromise, the grade varying somewhat, with the maximum about 2½ percent. In the mining panel it becomes somewhat steeper, ranging up to 3½ percent, although no effort is made to carry it at a definite grade.

On the main line No. 3 and No. 5 heavy-duty switches are used with cast-manganese steel frogs and parallel-throw switch stands with spring connecting rods. Similarly on the 40-lb. rail, save that No. 3 and No. 4 heavy-duty switches are used. Above the switches on main-line track red and green signal lights are used to indicate the position of the switch. Also in the shaft bottom area a system of automatic signals operated by the locomotives in passing is used for additional protection.

Length of main haulage is approximately a mile, one way. The 13-ton trolley locomotive hauls 20 5.2-ton cars per trip, or 104 tons, at the rate of 15 miles per hour, making the round trip in 15 min., after taking 7 min. for the run-around at the shaft and for picking up another loaded trip. The cars go into the tipple by gravity after the motor has been uncoupled. Present haulage capacity exceeds the dumping capacity of the tipple, which is, or can be made, approximately 250 tons per hour, and also exceeds the car-loading capacity at the faces. Thus it is apparent that the length of haul could be increased with the equipment on hand—in fact it could practically be doubled, according to calculations, although another locomotive would be required to do it steadily, this according to Mr. Harley.

Mining the Sulphate Ore on the 800 Level

Shuttle-car transport, employing a trackless-trolley system, serves for moving the langbeinite from face to transfer raise. Practice differs in other respects also from that on level below

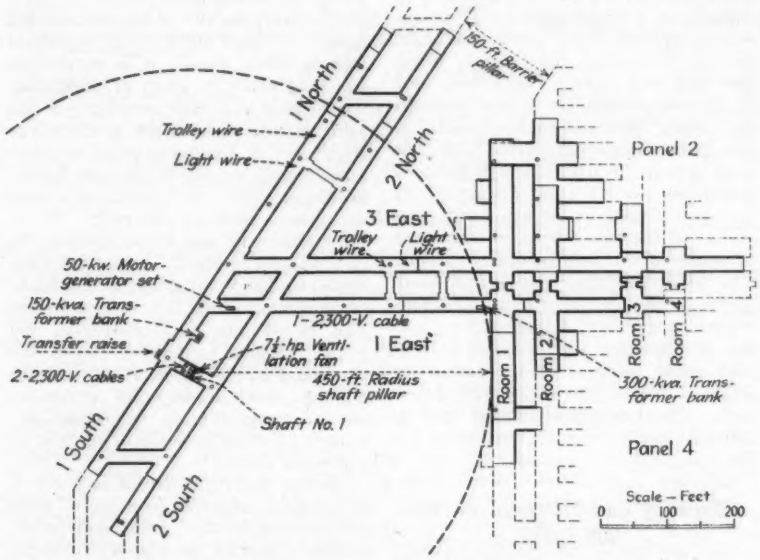


Fig. 6. . . . Workings on 800 level are confined to an area close to No. 1 shaft, as shown on this map. Here the langbeinite ore is mined by the room-and-pillar system

OPERATIONS on the 800 level, which has been opened on the No. 2, or langbeinite, bed, are markedly different in some respects from those on the level below. Although room-and-pillar mining with undercutting of the faces is used, the mining area is close to No. 1 shaft, instead of being several thousand feet away as on the 900 level; the panel layout is somewhat different, and the ore itself is different.

The first circumstance—the proximity of the mining area to the shaft—has permitted the installation of what is an interesting innovation in underground ore transport—namely, the adoption of rubber-tired shuttle cars operating on a trackless trolley system when in the main haulage entry and on an extension cable when in the rooms, this in contrast with standard trolley haulage of trains of cars on tracks used on the 900 level.

The use of these shuttle cars is the outstanding feature of the 800 level operations. The installation, moreover, is unique, being the only one of its kind known in the mining industry. Transport with rubber-tired shuttle cars equipped with storage batteries or cable reels, or both, it is true, has already been employed in coal mining to such an extent that it has lost its novelty. But the installation in the Union mine, consisting of cars which take their power from an overhead two-wire system, is said to have no counterpart elsewhere undgerground at the present time. The cars shuttle back and forth without turning between the loading faces and the transfer raise at the No. 1 shaft.

Comparison of the panel layouts on the 800 and 900 levels (Figs. 6 and 2 respectively) will show the differences between them. The 800 level layout was planned with the intent of making it more adaptable to the use of shuttle cars. Another purpose was to give closer control of the grade of langbeinite ore produced—that is, by providing a greater number of faces to make it possible to mine selectively and reject the waste if need be. It will be remembered that while the No. 2 bed is the most persistent on the property, the langbeinite within it is less continuous than is the sylvinite in the No. 4 bed below and frequently contains so much salt (halite) that it is discarded as waste.

As to the respective characteristics of the two ores, the langbeinite has a hardness of 3 to 4 in Moh's scale, which is about that of limestone, as against 2 for sylvite and 2½ for the halite, the two minerals composing the sylvinite. The langbeinite, moreover, is said to be brittle and fractures readily on impact, an advantage in drilling and blasting, whereas when a hole drilled in the salt or the sylvinite is shot, it may simply get larger. The salt tends to be tough and is rather compressible and the sylvite is even more compressible and correspondingly harder to shoot. Hence it is that a round in the langbeinite takes only half the powder that it would need in the sylvinite, although actually a greater quantity of powder is used here to prepare the ore for loading with the shuttle cars.

The difference in the langbeinite ore itself, as compared with the sylvinite, has caused the adoption of air drills in place of the electric post drills and auger steel used on the lower level. The langbeinite is too hard for effective work with the latter equipment. Detachable bits are used with the air drills, which are jackhammers operated on the so-called Mexican set-up.

The 800 level has been opened as on the level below by driving parallel entries 1N and 2N due north from the shaft and from these turning off at N.56 deg. 04 min. E, another pair, 1E and 3E, the entries on the two levels thus paralleling each other. No production has been made in the 450-ft. radius shaft pillar save that from the driving of these entries. At present the only connections between the two levels are the No. 1 shaft and the ore transfer raise immediately opposite it. On the 800, all entries are carried 20 ft. wide in contrast to the 900, where throughout the development campaign they were driven at a width of 15 to 17 ft. wide. The 800 level entries vary in height from 7 ft. to 9 ft., due to variations in the thickness of the langbeinite, which ranges from 5 to 7 ft., as well as to the roll of the salt. The rooms are 32 ft. in width.

For undercutting the langbeinite two machines are provided, a Sullivan 7B, having a 9-ft. bar with a standard chain and Super-Cesco bits, and a Goodman 512, also having a 9-ft. bar and using a special chain with the Goodman throwaway bit. These throwaway bits are reversible and despite their name can be resharpened, as many as four to six uses being had before they are discarded. Pins are used for anchoring the feed rope and the tail rope as on the level below.

In the mining cycle, assuming the face is clean, the undercutting or the drilling may be done first. It is somewhat preferable to do the former first, inasmuch as the drillers may then adapt their drilling to the way the cut has been made, whether up or down or on the level. The cutting operation itself is conducted as described for the 900 level, the machine being sumped in in the right corner. Ore is followed up or down, however it or the underlying salt may roll. The cut is made as close to the langbeinite as possible and in the salt usually 1 ft. below the langbeinite bed. The bottom is next brought to more or less uniform grade with the cuttings or bug dust, which is scraped back from the face and leveled by a drag or scraper pulled behind the shuttle car and sprinkled with water from the 1-in. line brought underground to supply the jackhammer drills. Any pronounced bumps in the salt floor are thus leveled off to provide a good roadway for the shuttle cars. In a short while this bug dust sets and forms a hard pavement in the entries.

On this level where there are no tracks one Joy caterpillar-mounted mining-machine truck has been provided for moving the two undercutting machines from face to face. This is powered through an extension cable and has a pivoted tilting bed for letting the machine on or off. The machine pulls itself up on the truck by anchoring to its back end with one of the ropes.

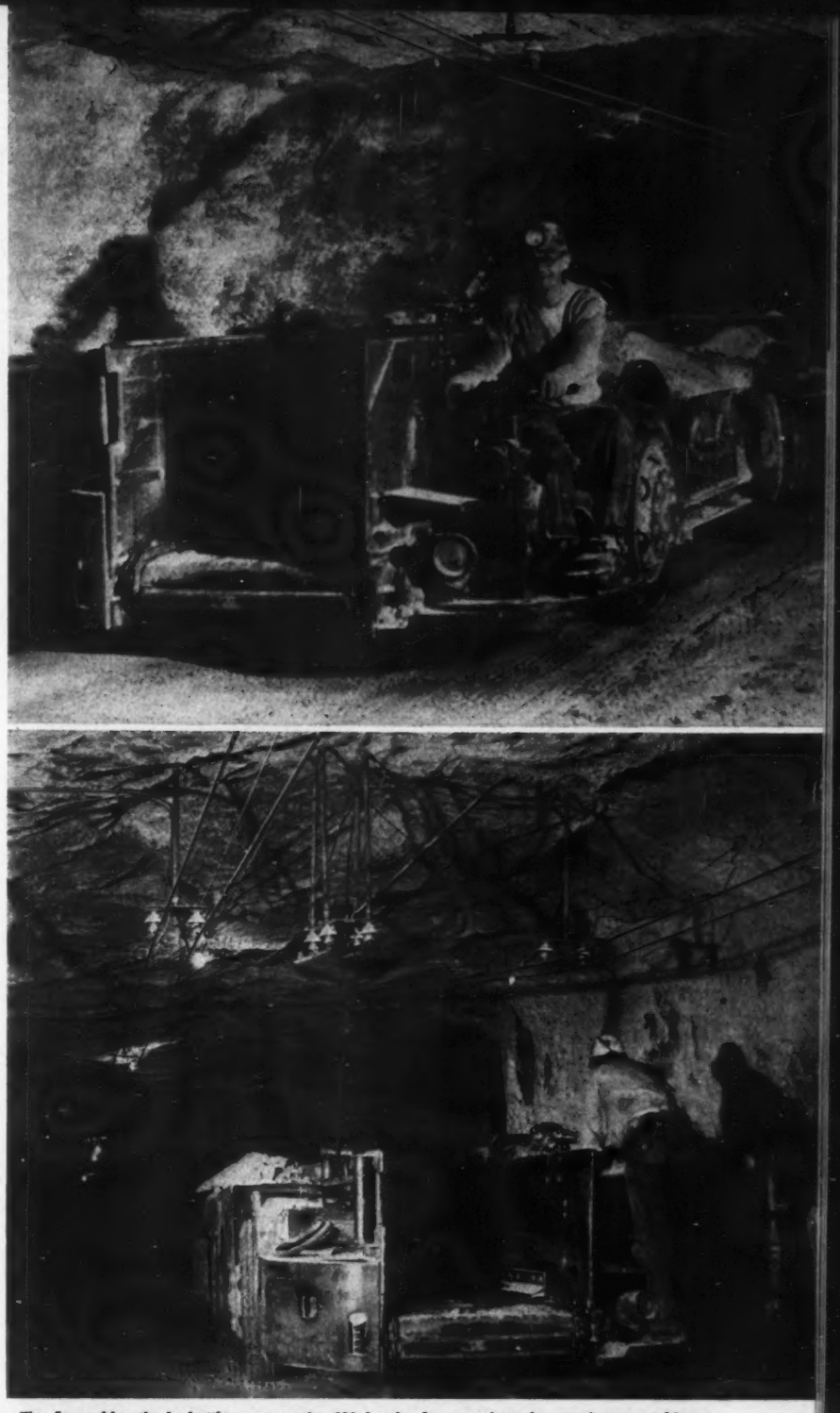
Drilling in the langbeinite is done with Ingersoll-Rand JA55 jackhammers. These machines are provided with a hook or ring at their midpoint, which is slipped over the collared end of a 1-in. steel bar about 7 ft. long. The collar is about 3 in. from the end of the bar. The lower end of the bar is pointed and rests on a plank. With the driller holding the bar at whatever angle to the vertical is necessary, and the upper end of the bar supporting the weight of drill as it drills its holes in the face, the operation proceeds. This method of supporting the jackhammer is known as the Mexican set-up. It is adequate for the drilling of a round of 9- to 10-ft. holes in the face of langbeinite ore with jackhammers. The chief difficulty is had with breakage of the drill steel due to the more or less unstable method of support.

Wet drilling is used, the dust otherwise being somewhat irritating. The only water in the mine, aside from drinking water, is that which is brought underground for this purpose and for sprinkling the roadway. The amount of water used is kept to a minimum. The bug dust in the face absorbs some.

Eight-foot and 10-ft. rods of 1-in. round steel are used with Sullivan side-hole detachable bits, 1¼ in. being the smallest diameter of the latter. The bits rarely require changing except when one breaks. Air is brought underground to the 800 level only in a 3-in. line, which with the water line is carried to the headings on the floor of the entries in one corner.

With the set-up described a man has averaged 30 holes per shift and has drilled up to 40 holes. The holes are spaced 4 ft. apart as in the sylvinite and the round is the same as that in Fig. 3. Three rows of holes are all that are required (27 holes per round in a 32-ft. face) to break the langbeinite, due to its friability.

The drills are moved from face to



The Joy rubber-tired shuttle cars on the 800 level. In one view the car is seen taking its power from the overhead trolley system. In the other view, the trolley pole has been pulled down and the cable from the reel attached to the "nips" overhead and the car is ready to enter the rooms. Both pictures show the discharge end of the car

face as needed upon the shuttle car.

After being drilled the holes are blown with air and the powder man loads and blasts with current from the 220-v. circuit, blasting usually on coming off shift or at lunch time. Du Pont Gelex No. 2 is used, the 8x1½-in. sticks running 150 to the 50 lb. box, and Du Pont D56 electric delays Nos. 1, 2, 3 and 4, the last being the slowest. The delays have 12-ft. copper leg wires.

Powder consumption on the 800 level is approximately ten sticks or a little less per hole. Owing to the height of the bed only three rows of holes are used in the round. In the bottom row of cut holes nine sticks plus the primer cartridge are used per hole; in the middle row of breast holes eight sticks plus the primer in all except the rib holes, which get one more stick; and in the back holes at the top six or seven sticks plus the primer, except in the two rib holes, which get ten sticks and the primer. Stemming is employed at times.

Shuttle Car Transport

Prior to the installation of the Joy loader on the 900 level for loading the Watt mine cars, this machine had never before been used in the Carlsbad district. Enough experience had been gained with it, however, on this lower level by the time the 800 level was opened up to show that its performance was quite satisfactory, so one was purchased also for the 800 level, where decision to install shuttle-car haulage had been made. Like the other loader, this one is a Type 11BU caterpillar-mounted unit.

The operations of loading and hauling on the 800 level are so interrelated that they can best be discussed together. The loader takes its 220-v., a.c. power from the nearest Miller connector through a 600-v., 3-conductor rubber-covered extension cable. Besides the loader operator a helper is required, who handles the extension cable, helps clean up the face at the end of the loading and puts the muck on the machine, picks down slabs, and acts as a relief operator in general.

Serving the loader are two Joy shuttle cars, each having an average capacity of 7½ tons of langbeinite ore. The gross weight of the loaded car is 13½ tons. The shuttle car runs on four rubber tires—two 9.75x20 tires on the rear wheels and two 7.50x20 tires on the front wheels. Pressure in these tires is 95 lb. at the discharge end and 115 lb. in the large tires at the hopper end. A service-station-type compressor near the shaft furnishes air for the tires. The loader discharges its stream of ore into the rear end of the car, which has a hopper-shaped bottom, running from which up to the front (or driver) end in the bottom is a chain flight conveyor by which the load from the hopper is moved up to the front so that more ore can be put into the hopper. This conveyor is actuated by its own 7½-hp. motor. As the pile in the hopper heaps up, the operator shifts it forward by running the conveyor at intervals until the car is fully loaded with the ore from end to end.

Thus, to muck out a heading a four-man crew is required, an operator and

W. P. Morris, assistant mine superintendent

his helper on the loader and one man on each shuttle car.

The car operates on 250-v. d.c., which it takes from the two-wire system overhead through a trolley pole, the trolley contacting both (4/0 grooved) wires. The current is delivered to two 7½-hp. motors, one on each rear wheel. A small G.E. motor-generator set having a 75-hp. motor and a continuous-current generator supplies this direct current to the system. The car shuttles back and forth between the loading face and the transfer raise without turning, one man being sufficient for its operation. It travels at a speed of 3½ miles per hour loaded and 5 miles per hour empty. On reaching the raise the entire load is discharged off the front end simply by running the conveyor again, the trolley pole is reversed, and the car returns. Red and green lights at the raise serve as signals to the driver whether to dump or not.

Jack Karichner, mine foreman

The overhead trolley wires extend from near the transfer raise in 1N entry opposite No. 1 shaft along the entry to its junction with 3E entry and along that to a point 700 ft. from the raise, at which point they terminate in the so-called nips, or contacts for the extension cable, of which the car carries 600 ft. on its reel (although the reel can accommodate more). Here, both going and coming, the car must pause while the driver pulls the trolley pole down and puts his cable on the nips. The maximum haul at the time of writing between the raise and the loading point was 900 ft., which is considered by the staff to be too long for the most efficient cycle.

Opposite Room 1 in Panel 2 in the 3E main haulage entry a trolley parting is provided about 100 ft. in length. This serves as a passing point for the shuttle cars. This room has been driven to the barrier pillar and stopped and is now being used for backfilling waste brought in by the shuttle cars and rehandled by the loader, which places it as close to the rib as possible.

The effective hauling time per 8-hr. shift for a shuttle car under the existing conditions is calculated at 6 hr., after allowing one hour for the crew to enter and leave the mine and to eat lunch and another hour for miscellaneous operations, such as scraping bug dust back from the face and moving the drilling equipment from one face to the next, and for delays due to breakdowns, waiting for smoke to clear, and for the loader to move to another face.

The overhead trolley was originally intended to take care of the main part of the haul, with the cable reel for the rooms. A long haul, however, causes too much waiting time for the loader. A possible alternative is now under consideration, consisting of installing a conveyor to run the full length of the panel entries and delivering to a raise at its junction with the main entry, with shuttle cars in the rooms. There appears to be no limit to belt length up to 3,500 ft.

The tonnage obtained with the loader and the two shuttle cars thus far, while satisfactory, has been well below that possible. A point for consideration in this connection is that the langbeinite mining operations are made to fit into the other operations centering on the production of sylvinite. There is a definite schedule for the 800 level, but it is made to stand aside as circumstances require.

P. S. Fagen, power superintendent and master mechanic

THE UNION POTASH ENTERPRISE

Mine Ventilation—Sampling —Power Distribution

Four large fans and numerous small ones in service. Diesel-generated electric power is distributed over the surface and to the most distant workings underground

DURING the 900 level development campaign a definitely planned ventilation scheme was in service, whereby 28,000 to 30,000 c.f.m. of air was blown from No. 1 shaft through the back entry to the breakthrough nearest the headings, the air returning through this and the main entry. A booster fan in each entry at its junction with the last breakthrough supplied its respective heading with adequate air through Ventube. Delay from powder smoke was as little as 5 min. just after a breakthrough had been completed; whereas just before the connection was made it might amount to 15 min.

With mining in progress the volume of air in the mine is approximately 30,000 c.f.m. on the 900 level and 8,000 c.f.m. on the 800 level. The manway of No. 1 shaft is lagged off and downcast, while the two hoisting compartments are upcast. In all there are four large fans and several smaller units. The large fans include (1) A La-Del-Troller ventilating fan handling 8,000 c.f.m. and driven by a 7½-hp. motor at the manway of No. 1 shaft on the 800 level. (2) A La-Del-Troller fan on the 900 level in 1E back entry about 1,700 ft. east of No. 1 shaft, driven by a 20-hp. motor and handling 30,000 c.f.m., driving it eastward through the entry. (3) A 42-in. Jeffrey Aerodyne fan handling 38,000 c.f.m., the total of the other two, and placed at the downcast lagged-off manway of No. 1 shaft at the collar. This fan, it is expected, will ultimately be able to deliver 75,000 c.f.m., but not now, owing to the restricted area of the manway. At present it is driven by a 35-hp. motor which is to be changed to 60-hp. The other two fans can also handle a larger volume of air. Cloth brattices are commonly used throughout the mine to control the direction of the air currents.

A duplicate of the 42-in. Aerodyne fan that stands on the surface at No. 1 shaft is waiting at the collar of No. 2 shaft until the latter can be placed in service.

In addition to these larger fans, there are a number of smaller units, mostly of Coppus make (Ventair), in the mining panels on each of the two levels. Such a fan is usually to be found in each room at the point where it is turned off from the entry, together with a length of 16-in. Ventube sufficient to take the air into the heading or past the nearest breakthrough.

A detailed study of the ventilation of the mine is under way.

In driving headings on both levels an effort is made to get the complete height of minable ore. To achieve this the undercutting machine is pitched up or down as may be necessary in order to cut at the bottom of the ore. Although the last samples taken may show that the face should be in ore, the salt under the bed may unexpectedly go up or down. A face is sampled after each round, down the middle from top to bottom, if the ground appears to be uniform. Otherwise, on the 900 level, if the ground varies from top to bottom, samples are taken between the roof and the top salt marker, between the top and bottom markers, and between the floor or foot and the bottom marker. If the face varies across the width, two vertical rows of samples may be taken. The two may be averaged or the mining may be done selectively. This is especially true on the 800 level, where an effort is made to maintain a certain grade of langbeinite mined. Such samples are for the purpose of controlling the mining.

For the permanent record a sample is taken every 25 ft. on the left rib of entries and pillars. If the height of the entry differs from that of the ore, two samples are taken, one for the full height of the ore and the other for the height of the heading.

Much of the repair and maintenance work required by the equipment underground is done in temporary shops provided on the 800 and 900 levels. These are usually located near the shaft in some breakthrough between the entries. For example, in No. 1 breakthrough between 1N entry and the shaft runaround on the 900 level is an electrician's shop for repairing the electric drills and locomotives. A stub track serves it. In another breakthrough between 1N and 2N on the 900 level is the general maintenance shop, through which runs a continuous track. Permanent shops will be located adjacent to No. 2 shaft.

Fire-fighting equipment consisting of extinguishers is kept in each shaft station and various other points elsewhere on the two levels. At certain points also first-aid cabinets are maintained with a stretcher beside each.

Prominent on the surface, the power house is a Transite-covered steel-

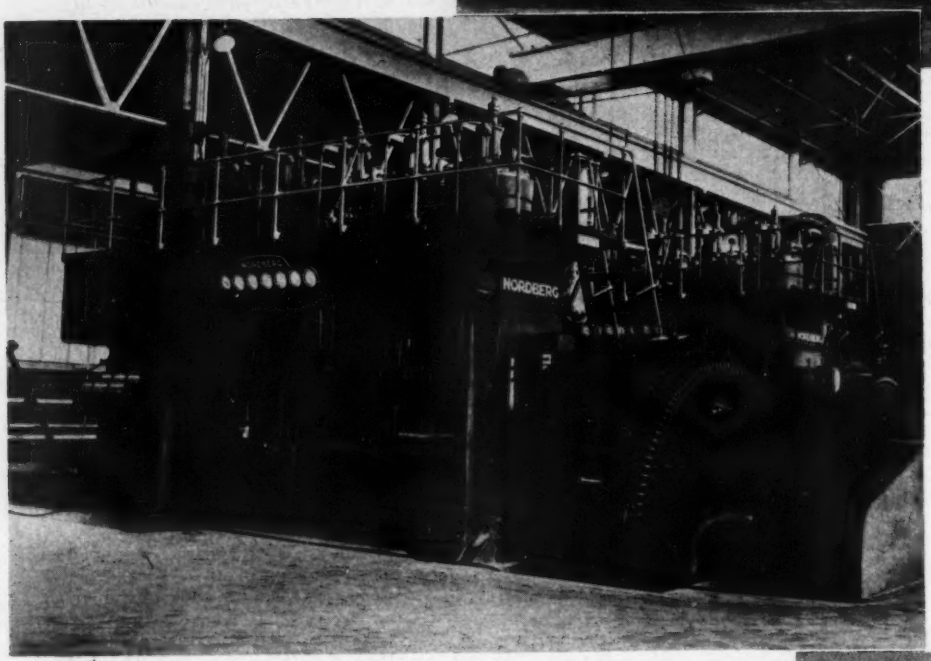
E. C. Anderson, plant engineer

This 42-in. Jeffrey Aerodyne fan at the collar of No. 1 shaft supplies 38,000 c.f.m. to the mine via the lagged-off downcast manway

THE UNION POTASH ENTERPRISE

POWER for Mine and Plant

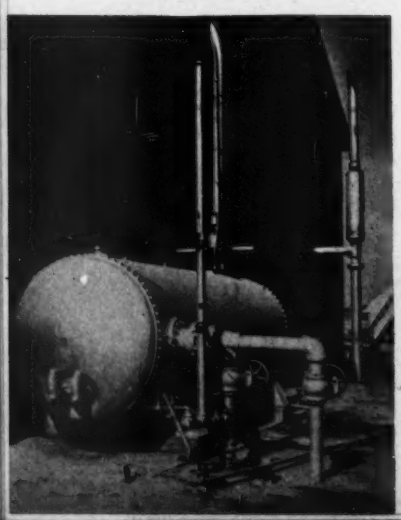
Housing the equipment of the power plant is this 85x144-ft. steel-frame building covered with Transite and with copper flashing over window frames and door frames

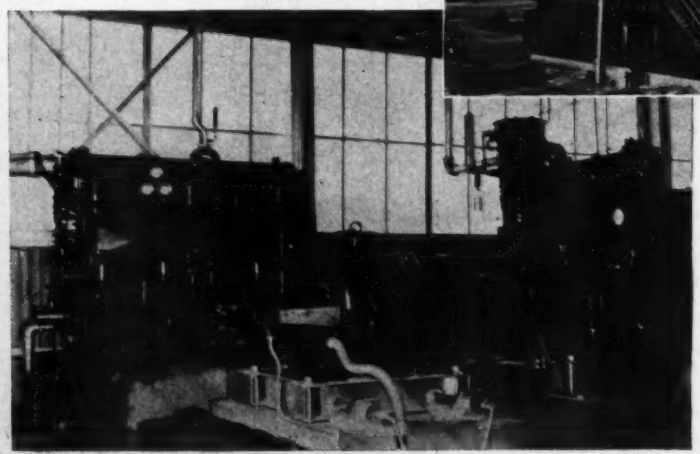


Four diesel-driven generators supply the electric power needed for operation. They include these two new 1,250-hp. Nordberg two-cycle engines, each driving a 1,000-kva. Westinghouse generator. A third similar unit is on order. The other two diesels are respectively of McIntosh & Seymour and Carels make

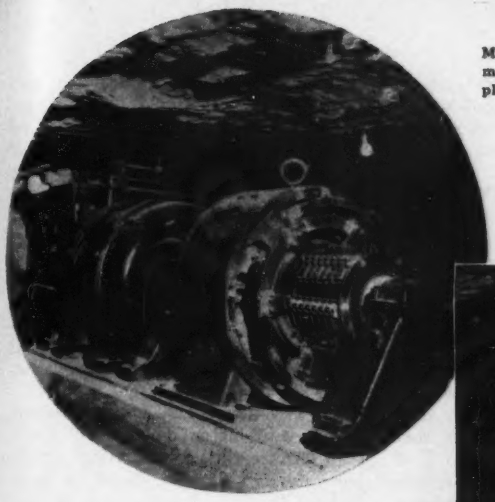
This Fluor aerator tower outside the power plant serves for cooling the diesel jacket water. It is built of redwood

Receiver of the mine compressor, outside the power plant



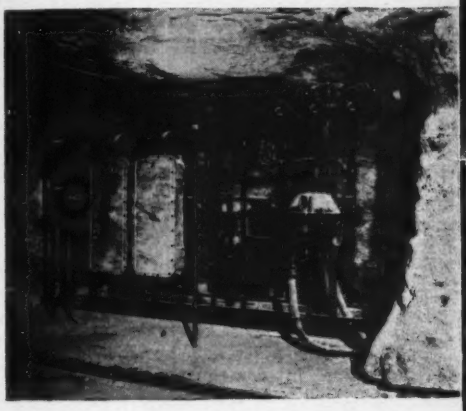


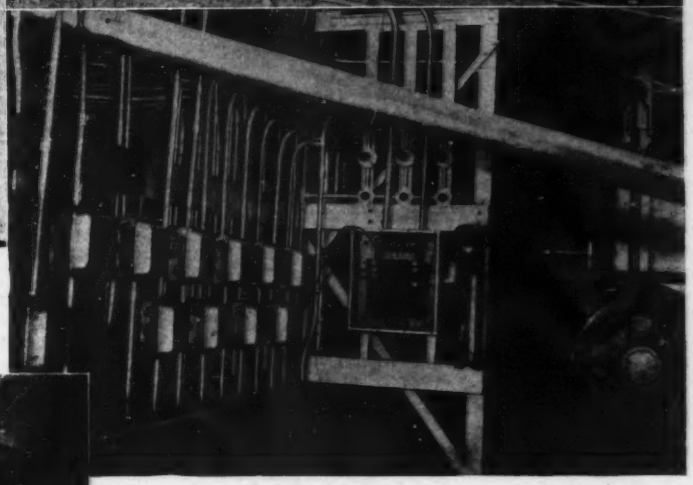
Also in the power plant is this Sullivan compressor for supplying air for drilling the langbeinite on the 800 level. It is driven by an Atlas Imperial 104-hp. diesel engine



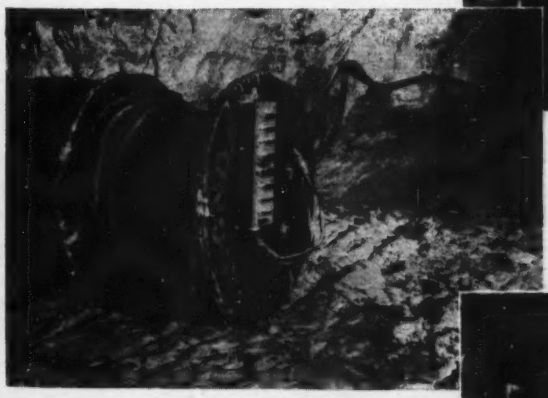
Motor-generator set, of Westinghouse make, on 900 level near shaft, for supplying 250-v. direct current for the trolley haulage system

Two sets of portable transformers in breakthrough between 9 N and 10 N entries opposite Room 2, Panel 3, on 900 level. Each consists of three 50-kva. Westinghouse pot transformers for stepping down current from 2,300 v. a.c. to 220 v. for use in mining area. One set has been skidded off its truck



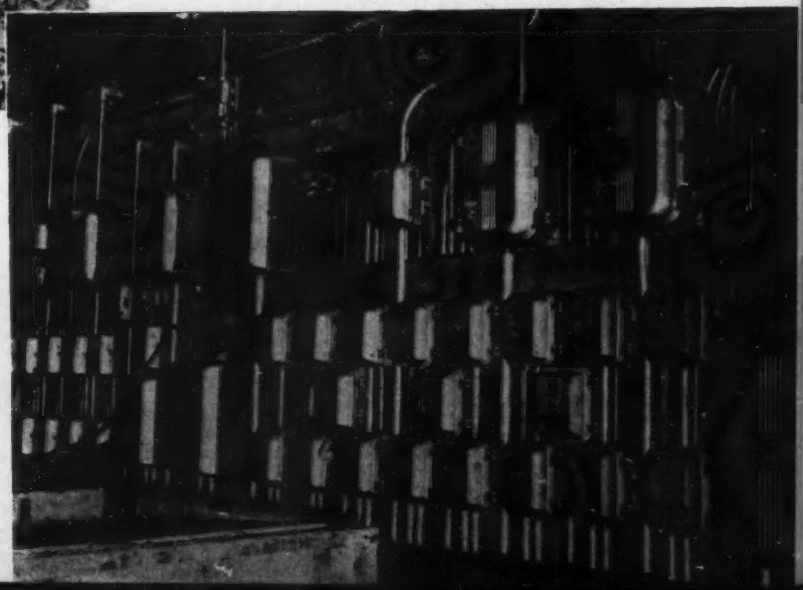


Transformer substation in 1 N entry just north of shaft on 800 level, for stepping current down from 2,300 v. a.c. to 220 v. It comprises three G.E single-phase 50-kva. transformers



One of the several switchboards in the refinery. At the right is the motor that drives the 6x12-ft. rod mill

Another of the refinery switchboards



In carrying power from the transformers to points in the mining area where it can be tapped for operation, the last length of 2,300-v. cable is usually kept on its reel, as here seen, and run out as needed. It terminates in a Miller connector on the side of the reel into which the various operating units, such as loaders and undercutters, can be plugged

framework building, 85x144 ft. in plan, with copper flashing over the steel window frames and door frames. The steel work was erected by Mosher Steel Co., of Dallas, Texas, and the Transite covering applied by Macatee, Inc., also of Dallas. Foundations were built by Union Potash. The building houses four diesel-driven generators with their switchboards and all accessory equipment. The four units comprise two new 1,250-hp. 2-cycle Nordberg diesel engines, each driving a 1,000-kva. Westinghouse generator; one McIntosh & Seymour 500-hp. diesel driving a 400-kva. Westinghouse generator; and one 1,250-hp. Carels diesel driving a 650-kw. G.E. generator. The two diesel engines last mentioned have also seen service elsewhere.

In this building also is the compressor that furnishes air for the drills on the 800 level. It is a Sullivan Class WN-32 14½x8⅝x10-in. machine driven by a 104-hp. Atlas Imperial diesel engine.

Fuel oil for these diesel engines comes from the Skelly Oil Co.'s Getty lease 10 or 15 miles away in the same district. This oil contains no light fractions. A supply of 32,000 gal. is stored outside the plant in four steel tanks, two of 11,000-gal. capacity each and two of 5,000-gal. capacity.

Of the numerous units of accessory equipment may be mentioned the six Ross heat exchangers used in the diesel cooling system. Four of these serve the new Nordberg units and the other two the older diesels. Also in the diesel cooling system but outside the building is the striking Fluor aërator cooling tower, built by the Fluor Corporation, Ltd., of Los Angeles, entirely of California redwood. It serves to cool the jacket water. In the basement of the power house are two DeLaval industrial centrifugals. One cleans the fuel oil before it enters the engines and the other cleans the lubricating oil for recirculation. In addition there are numerous pumps of various kinds, notably some of Goulds make, and for various purposes. Two of the Goulds pumps circulate fresh water through the engine jackets. The building is serviced by a 20-ton Maris crane.

Equipment was on hand in February for air-conditioning the power house. This part of New Mexico is visited by severe dust storms from time to time, especially in the spring, and it is proposed to keep the dust out of the building, particularly out of the diesel and compressor intakes. To this end a No. 7AHS Sirocco blower, to be driven by a 10-hp. induction motor, and an American Blower Corporation capillary-type air washer were on the floor awaiting installation. When this is complete the power house will be completely enclosed, all air entering through the new installation and leaving through the ventilators in the peak of the roof.

Power from the four generators is delivered at 2,300 v., a.c., to the main bus in the power house, first passing through an oil circuit breaker in each case. From the bus it is taken off again in eight separate 2,300-v. circuits, first passing through an oil circuit breaker in each circuit. These circuits are:

1. 4/0 3,000-v. insulated, wire-armored cable, 2,300 v., to transformers to water-well pumps.
2. 4/0 cable, 2,300 v., to No. 2 shaft, to transformers. At this point the Union company's line is tied in with that of the neighboring United States Potash Co., on which it occasionally draws for power to supplement its own production.
3. 4/0 cable, 2,300 v., to storage and loading building to transformers.
4. 4/0 cable, 2,300 v., to main hoist.
5. 4/0 6,000-v. insulated cable, 2,300 v., to mine circuit, to transformers.
6. 250,000 circ. mil cable, 2,300 v., to mill, to transformers.
7. 4/0 cable, 2,300 v., to power house transformers. Secondary cable is 1,000,000 circ. mil cable, 440 v., for service to power house pumps, etc., shops, office, and general surface utilities.
8. 4/0 cable, 2,300 v., to crushing plant to transformers.

Following the mine circuit underground, the 4/0 6,000-v. insulated cable listed in the preceding is wire-armored, lead-sheathed, jute-wrapped, cambric-insulated, 3-conductor borehole cable of the General Cable Co. Additional insulation is provided because it passes through the shaft. It goes to the primary cutouts in the main substation on each level. From these substations 2/0 steel-tape-armored, lead-sheathed, jute-wrapped, rubber-insulated, three-conductor Parkway cable (3,000-v. insulation) of Anaconda make feeds to all transformers and motor-generator sets. Besides the transformers in the substation near the shaft on the 800 level and in that on the 900 level, which furnish 220-v. current for the shaft bottom area on the respective levels, there are several banks of three pot transformers each, each bank mounted on a truck. These are distributed throughout the mining areas, to supply the units in those areas. An effort is made to keep a bank not more than 1,000 ft. from a working face and preferably within 500 ft. A new portable 300-kva. air-cooled transformer is on order. It will necessitate moving only one instead of three at a time.

For secondary 220-v. power distribution, 4/0 600-v. 3-conductor Duraseal (Anaconda) cable having a rubber and non-metallic sheath is used. It runs from the transformers up into each room, branching in the entry and going to the Miller connector boxes. The various units of equipment are plugged into these boxes, using Tyrex extension cord of suitable size. It comes in several sizes. The Miller connector, made by the Mines Equipment Co., of St. Louis, has two large outlets, for the undercutters and the Joy loaders, and five smaller ones, for booster fans and, on the 900 level, the electric drills.

Mine lighting is done from a 110-v. a.c. circuit. In the stations 100-watt lamps are used; in the entries 50-watt lamps at 100-ft. intervals; and in each working place a 200-watt lamp. The mine in consequence is excellently lighted. A factor that helps is the relatively light color (red, pink, light brown) of the clean walls of sylvinite, salt, and langbeinite, in strong contrast to what is customarily met in the average metal mine. A much larger percent of the artificial light is reflected than in the latter case. All miners, moreover, wear Edison electric cap lamps.

The Change House

A well-built change house has been provided at No. 1 shaft. It is of steel with a cement floor and corrugated galvanized iron wall inside and outside and insulation between, and a ceiling also of galvanized iron. Lockers are provided for 140 men, each having a wire basket and rope on an overhead pulley besides. Equipment includes Bradley wash fountains, showers, and toilets; also Carrier gas-fired automatically controlled heaters on the end-walls at the top and a Crane gas-fired hot-water heater.

On the 900 level in 1 E entry, 1,700 ft. east of No. 1 shaft, is this La-Del-Troller fan handling 30,000 c.f.m.

A Coppus Ventair blower in a room in Panel 3 on the 900 level of the Union mine

In the Refinery

Flotation and other milling processes play a part in the flowsheet of the plant. Products include muriates and sulphate; also washed langbeinite

J. A. Mackenzie, refinery superintendent, left, and B. W. Jacobs, refinery foreman

THE CRUDE POTASH ORES, containing potassium chloride (or muriate) and the double sulphate of potash-magnesia (langbeinite) respectively, hoisted from the Union mine are prepared for market in a new plant that stands immediately adjacent to No. 1 shaft. Though some crude salts are stocked temporarily on the ground near by, this plant is normally handling the current output of the mine, which, as previously stated, is somewhat more than 2,100 tons of sylvinite and langbeinite ores combined per day. These ores are hoisted separately and treated separately throughout, although from the two combined after treatment, an additional final product, potassium sulphate, is made.

At present the final products are five in number. These are:

1. Regular muriate of potash, or KCl, of a guaranteed minimum K_2O content of 60 percent.
2. 50 percent muriate, running 50 percent K_2O.
3. Granular muriate, this being a coarser fraction made in the treatment process and also running 50 percent K_2O.
4. Sulphate of potash-magnesia, or washed langbeinite, running 22 percent K_2O (or 40 percent K_2SO_4) and 18.5 percent MgO. This product is totally water soluble.
5. Sulphate of potash (K_2SO_4), running 48 to 50 percent K_2O.

Of the crude tonnage hoisted, the salt fraction is being discarded at present in the refining or preparation process in the form of tailings, or as waste salt brine solution, both valueless at the plant.

Preparation begins with crushing, the first reduction, to minus 4-in. size, being made underground. The crushed ore is hoisted to the two 250-ton shaft bins (photograph 1), from each of which it is fed by a pan feeder delivering to a belt conveyor that enters the crusher building (1). Here the ore is further reduced in a Jeffrey Flextooth crusher (2) followed by hammermills (3) of the same make, with screening done on Jeffrey-Traylor vibrating screens (4). The crushed products are delivered by conveyors (5), after being weighed, to five crushed-ore storage bins (1), two re-

1. Crusher building, with shaft ore bins at left, crushed-ore storage bins at right

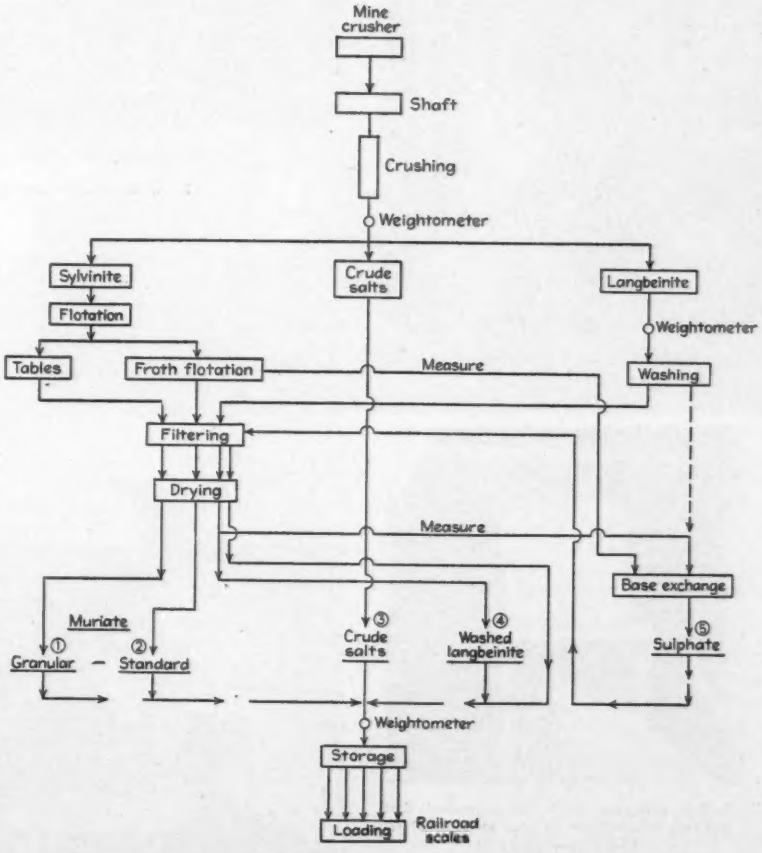
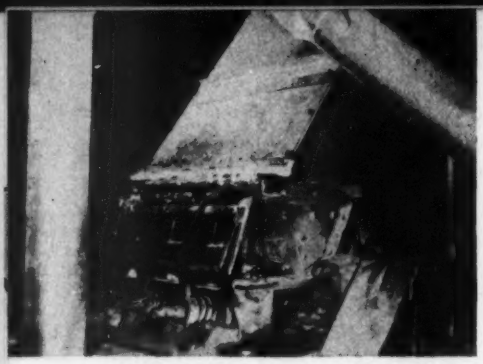
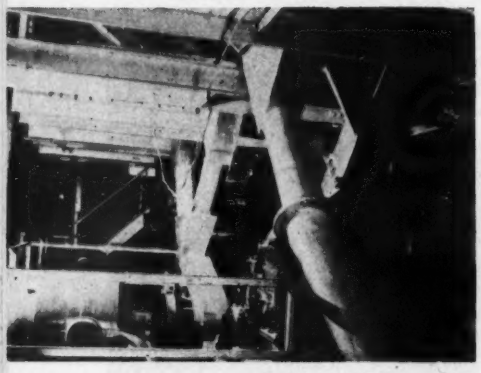


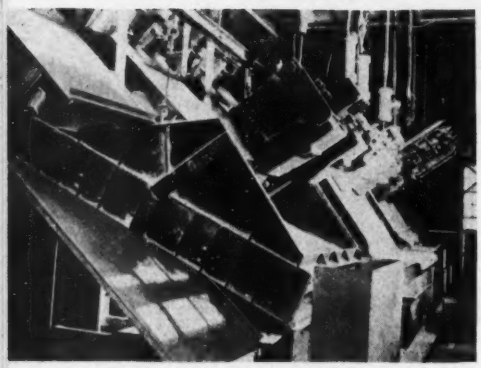
Fig. 7. . . . A generalized flowsheet of the refinery of Union Potash & Chemical Co.



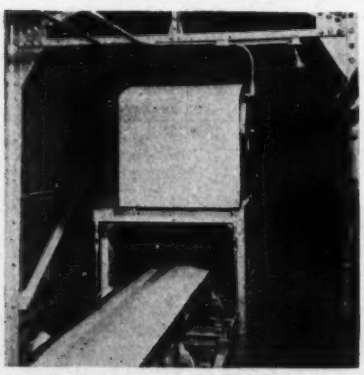
2. Flextooth crusher



3. Battery of hammer mills



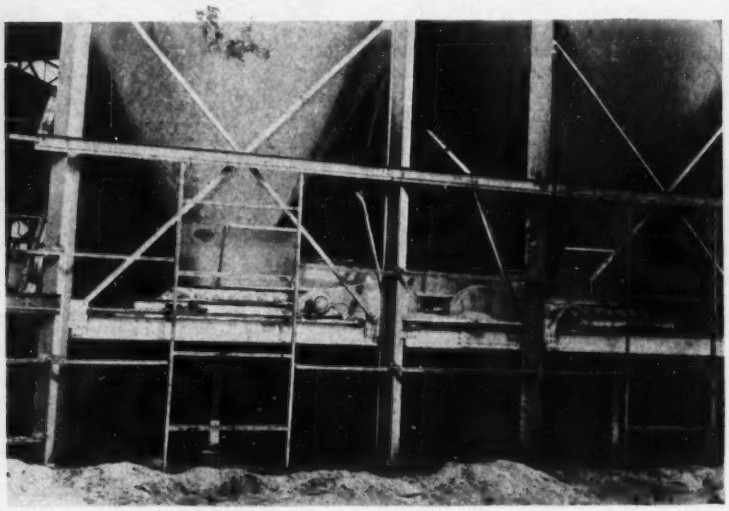
4. Vibrating screens in crusher building



5. Belt conveyor (with weightometer) that delivers crushed ore to bins at head of refinery (See photo 1)

ceiving the sylvinite for treatment and two the langbeinite. The fifth is used for such crude mine-run ore as it is desired to ship directly. These bins stand at the head of the refinery building, several hundred feet from the crusher building. A shuttle conveyor on top of them distributes the ore to the individual bins as required.

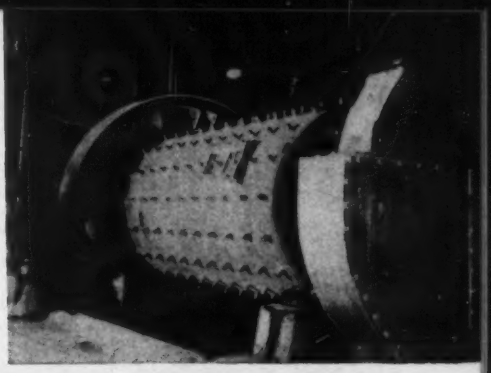
The order of the principal steps in the treatment given the ore in the refinery is shown in the general flowsheet on page 65. The sylvinite ore, containing the potassium chloride (sylvite) and the sodium chloride (halite) is treated by flotation to float the sylvite from the halite. This is done partly on tables and partly in flotation machines, the respective granular and fine products being filtered separately and dried. The langbeinite is washed to remove the halite, or common salt, that accompanies it, and is filtered and dried. Part of it is shipped as washed langbeinite and part of it is ground in brine in preparation for subsequent reaction with part of the fine muriate in solution, for the production of potassium sulphate. In this reaction, the potassium muriate or chloride (sylvite) and the sulphate of potash-magnesia (langbeinite) exchange bases to yield potassium sulphate and magnesium chloride. The latter at present is sent to waste. The rest of the fine muriate, or sylvite, after being dried, goes to storage for shipment.



6. Apron feeders under crushed-ore storage bins

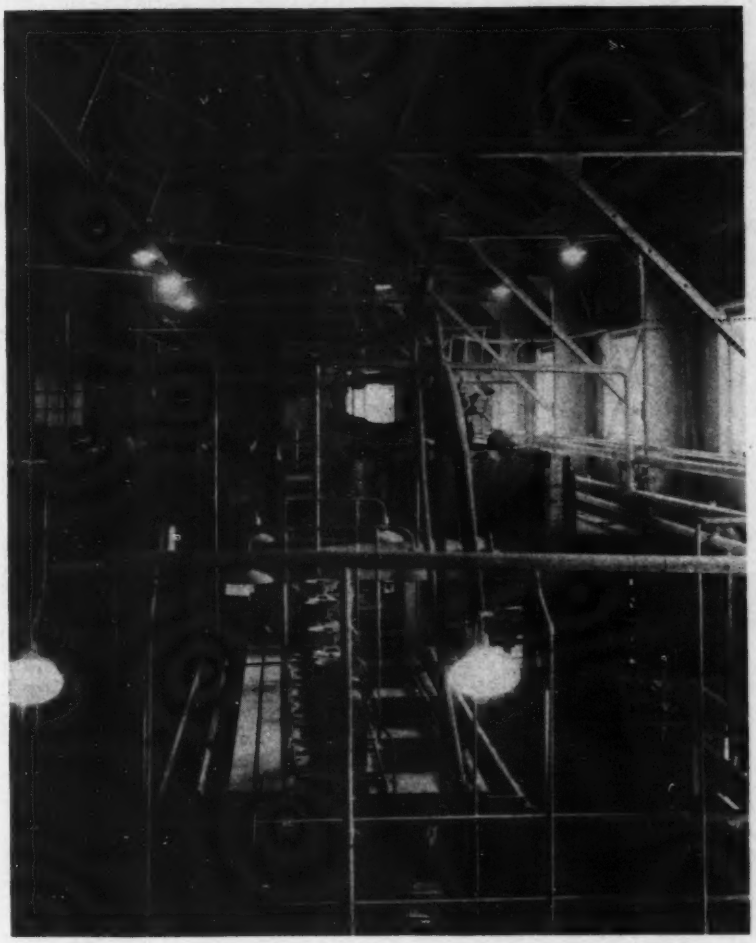
7. Duplex rake classifier and hydroseparator treating overflow

8. Duplex spiral classifier in closed circuit with rod mill (9)



9. 6x12-ft. rod mill grinding sylvinite

10. Froth flotation section of mill. Rougher cells above, cleaners below (re-cleaners out of picture)



To describe this in somewhat more detail, the 5- to 8-mesh sylvinite ore drawn from the crushed-ore storage bins (6) is mixed with brine and sent to an FX duplex Dorr rake classifier (7). This stands outside the mill at some height above the ground. A tonnage split of the rake product is made, part going to tabling and part to froth flotation. The classifier overflow is further treated in an adjacent hydroseparator (7), the underflow of which joins the portion of the rake sands sent to the flotation machines. The hydroseparator overflow goes to two thickeners for recovery of the brine.

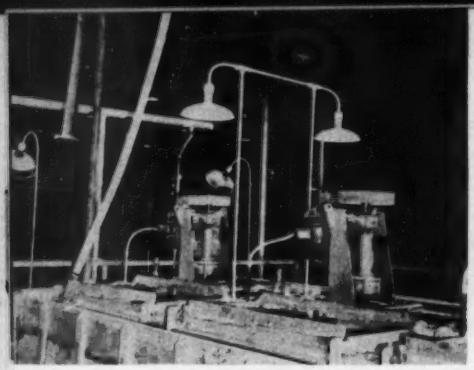
The portion of the Dorr rake product that is to be floated in the machines is delivered for grinding to a duplex Akins classifier (8) in closed circuit with a 6x12-ft. rod mill (9) which grinds to minus 35 mesh. The Akins overflow is pumped to eight 54-in. Fagergren rougher cells (10), the reagents being added in both the pump and the cells. Rougher tails are thickened and filtered, the solids going to the dump. Rougher concentrates are cleaned in four similar cleaner cells (11), the cleaned concentrates being further cleaned in three re-cleaner cells. Flotation tails are filtered on two 6x8-ft. Oliver filters (12) and sent to the dump.

Re-cleaned concentrate is split at 80 mesh in a simplex Akins classifier. The plus-80-mesh size is filtered on a top-feed Oliver filter and dried and sent to storage. The minus-80-mesh material is thickened (13) and the thickened product is filtered on a tank-type Oliver filter. Part of the filtered product is dried and stored for shipment as fine muriate and part is sent to tanks, in which it is dissolved for the reaction with dissolved langbeinite in the base exchange process. The sulphate resulting from the base exchange is filtered on an Oliver (14 and 15), dried ond stored.

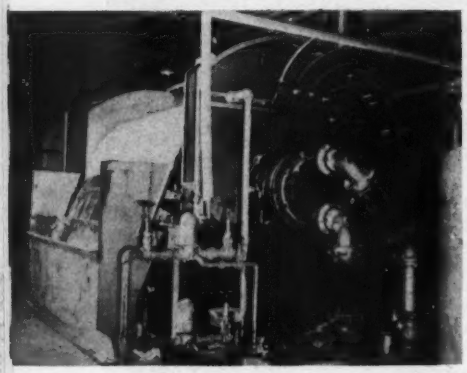
That part of the rake product of the duplex Dorr classifier that is tabled (for the purpose of providing a granular muriate) is first put through a trommel followed by two Jeffrey-Traylor vibrating screens having 22-mesh screens. The plus-22-mesh oversize is conditioned with reagents in a drum mixer that discharges into a rotating six-way splitter (16) that distributes the feed to six Superduty diagonal-deck tables (17), from which is recovered the coarse granular muriate that, when dewatered on a Esperanza-type drag and dried, is one of the finished products. It is sent to storage for shipment. The table tails are dewatered on a chain drag and sent to the dump, where they are spread by a stacker conveyor.

The washing of the langbeinite to remove the halite, or salt, that occurs with it depends on the relative solubility rates of the two minerals in water. Crude ore drawn from the crushed-ore storage bins, by apron feeders, is delivered by belt, after being weighed en route, to a screw conveyor in a trough where it is mixed with water, and the dissolving of the halite begins. The screw delivers to a duplex Dorr rake classifier, where further solution of salt takes place and at the same time dewatering is effected, this separating the halite as brine from the undissolved langbeinite. The rake product is filtered on a top-feed Oliver and dried and stored, as washed langbeinite. If wanted for the base-exchange process it is taken from the shift bin and ground in a ball mill (18) in circuit with a simplex Akins classifier, the overflow of which goes to the reaction tanks.

A 150-hp. boiler (13), with a similar standby unit, furnishes such steam as may be needed for various purposes in the refinery. It is not drawn upon to capacity.



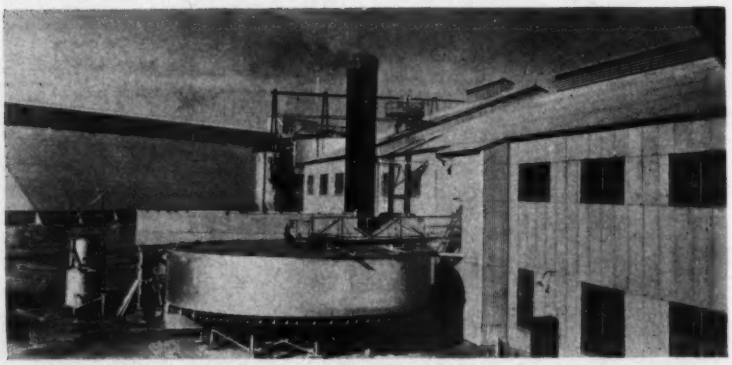
11. Two of the recleaner flotation cells



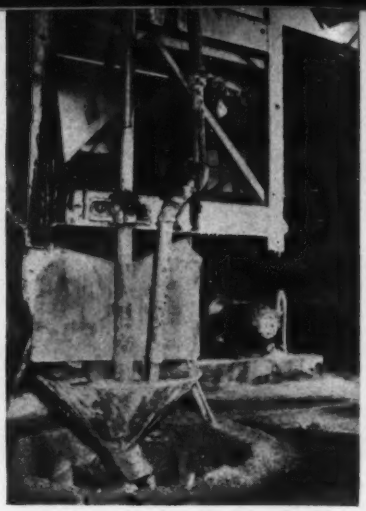
12. Drum filters working on flotation tails

For the various filtering operations mentioned six drum filters in all are provided—two for the tailings from froth flotation and the remaining four for filtering the individual products before drying. These four are arranged so that they can discharge their cake directly on to a conveyor that delivers it to a dryer. Four of the six filters are served by three Roots Connersville blowers (19) and two by an Ingersoll-Rand vacuum pump.

Flotation tailings, largely halite, are run by conveyor belts to a dumping point outside the plant, from which they are then spread with a stacker conveyor (20). Mill-waste solutions, on the other hand, principally the water used to dissolve the salt out of the langbeinite in the refinery, are now impounded on a 60-acre tract behind a dike or dam 1,700 ft. long with a maximum fill of 13 ft. and having a core wall of pudd'ed mud throughout its entire length. This is 1½ miles from the plant. The purpose is primarily to keep these brines from polluting the wells from which the plant supply is obtained. The tract and connecting ditch are fenced to keep cattle from foundering in the boggy ground. The ditch has likewise been concreted from the mill to the point where it enters upon the tract.



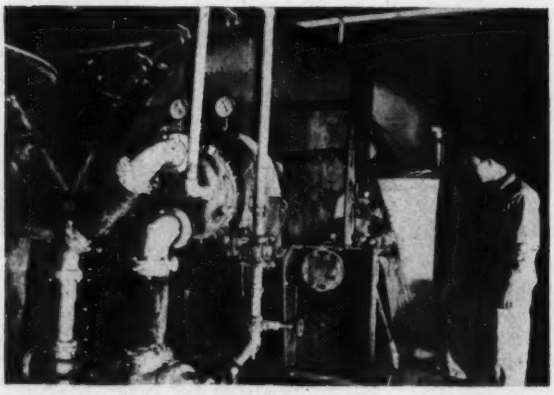
13. Thickener handling fine flotation concentrate before filtration. Boiler plant behind it.



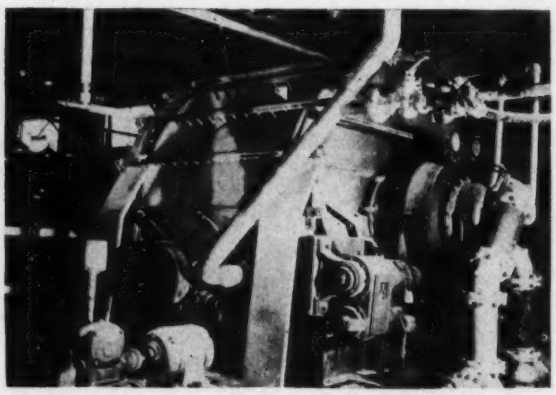
16. Six-way splitter distributing conditioned feed to tables

Drying is done in four 5x40-ft. rotating kiln dryers (21) made by Struthers-Wells Titusville Corporation. These are parallel flow dryers fired by natural gas of approximately 1,060 B.t.u. content per cubic foot (guaranteed to be 1,000 B.t.u.). The building up on the inside of the shell of the product being dried is combated in each dryer by the use of a weight suspended on a lever arm over the shell, which is made to rise and drop again, by means of a cam on the outside of the shell, striking the shell in each revolution.

When dried, the finished products are elevated to temporary storage. Each dryer discharges to an elevator which in turn delivers to one of four 60-ton steel bins set in a row. These bins are known as shift bins and serve for temporary storage in the refinery. From each the product stored is drawn from time to time on to a belt conveyor which delivers it to a 24-in. belt conveyor, 360 ft. (22) long that runs to the top of the main storage building, where a shuttle conveyor (23) in turn receives it for distribution to the various storage piles. In the temporary storage shift bins mentioned the respective products are not allowed to remain for long, lest they set and harden. It is from one of these



14. 6x4-ft. bottom-feed filter handling potassium sulphate



15. Same filter as in photo 14 but seen from opposite side

that washed langbeinite is drawn as needed, to be ground for base exchange.

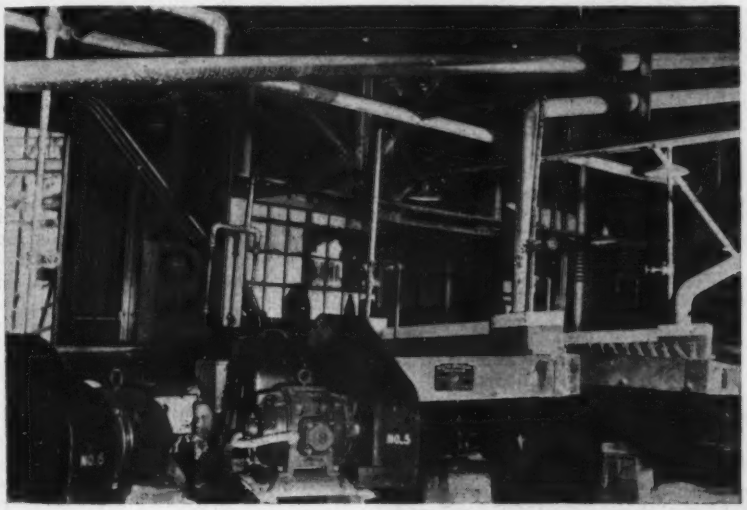
The dryers are housed at their discharge end for dust-collection purposes, the system having been installed by Union Potash. The finer dust and the gas are removed to the outside of the mill through a 90-ft. duct by means of a 5-in. No. 6 American Blower fan, where the dust is caught in a water spray while the gas and steam escape.

Throughout the crushing plant and the refinery wherever dust is likely to be encountered, the workmen are provided with respirators, particularly of the Dustfoe type, and are obliged to use them.

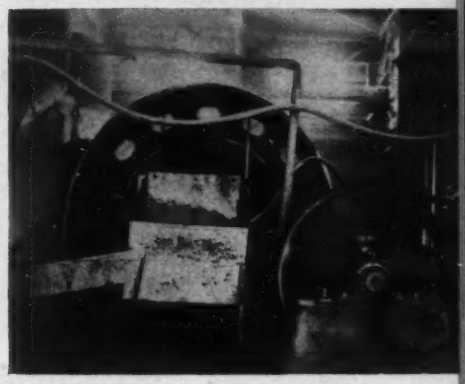
The storage building is 600x102 ft. in plan. It is a steel-frame structure of arch-ribbed type of construction having a corrugated iron roof, and was built by Patterson Steel Co. An exterior view is shown in a photograph shown on page 45. The outside of the building is covered with No. 22-gage corrugated galvanized sheet.

On the loading-out side of the building, at each end of the concrete floor on to which the finished products stored are dropped in their respective piles from the overhead shuttle conveyor, is a 10x10-ft. opening covered by a grid. Midway along the same side is a similar opening, there being three of these openings in the floor in all. Near each opening is a Sullivan three-drum scraper hoist (24) powered by a 50-hp. Westinghouse motor and operating a box-type scraper. A tripod-mounted floodlight having a 1,000-watt lamp furnishes light for each of these units. By means of these scrapers are reclaimed for shipment,

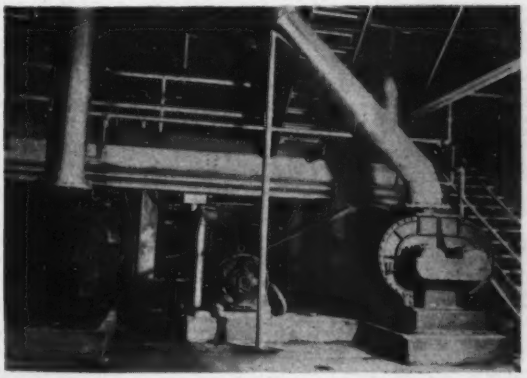
17. The diagonal-deck concentrating tables



18. Ball mill grinding langbeinite for base-exchange process

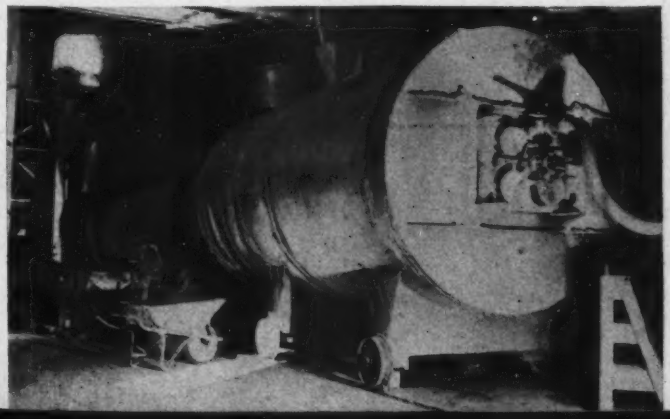


19. Two of three blowers serving filters



20. Stacker conveyor handling flotation tailings

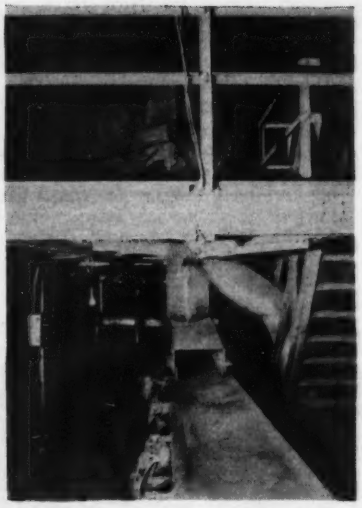
21. One of four gas-fired dryers



22. Conveyor delivering finished products to storage

as desired, the potash salts stored, the material being dragged into a hopper beneath each opening. In the chamber below each hopper is a Jeffrey-Traylor vibrating screen (25), followed by a Jeffrey hammer-mill, this equipment being provided to break up lumps that may be formed by the material setting and hardening while in storage. It may even be that the material stored in the piles on the floor above has to be blasted before it can be scraped into the hoppers. It is because of this possibility that the unusual type of building shown is provided and that a loading tunnel is not employed.

The now re-screened and crushed material is delivered in each of the three crushing chambers to a short conveyor that raises it to ground level and delivers it to another conveyor, in the case of each of the two end units, and to an elevator in the case of the middle unit, all of which deliver respectively to the top of three "loading-out" bins in a covered structure just outside the storage building and midway of its length.

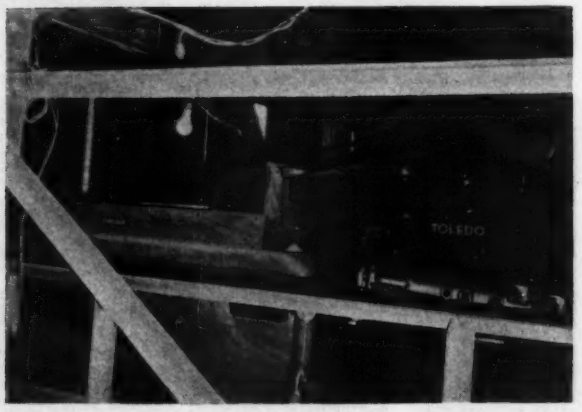


23. Conveyor from refinery (above) delivers to shuttle conveyor in top of storage building

24. (Left) In storage building—one of three scraper units for reclaiming

25. (Below, left) One of the three screen-and-hammer-mill units under floor of storage building

26. (Below) Vibrating, constant-weight, control feeder under loading bin



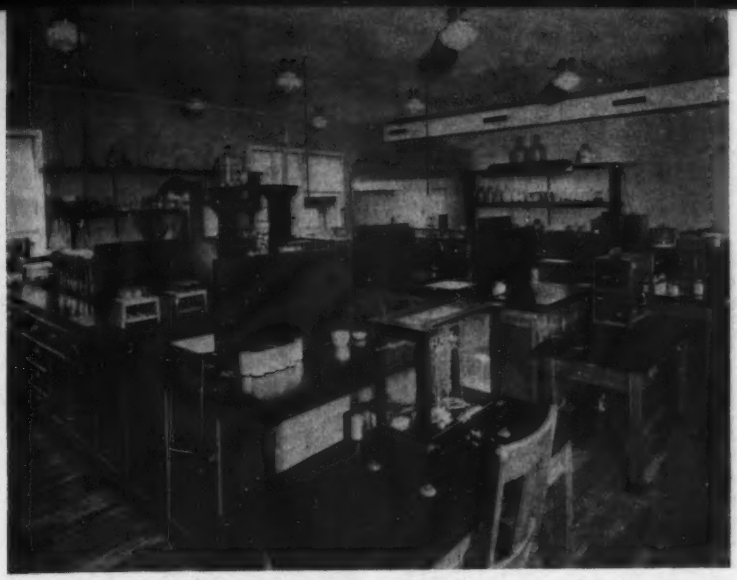
Each of these loading bins is provided with a Jeffrey-Traylor vibrating constant-weight control feeder (26) which delivers either to a conveyor that in turn discharges to an Ottumwa box-car loader (27) and so to the railroad car, or else drops the material into the boot of an elevator which raises it to the top of the building for further screening and crushing, if lumps have formed meanwhile in the loading bins just mentioned. There are two such elevators, each delivering to another vibrating screen followed by a Flextooth crusher. Two box-car loaders are provided.

Water for use in the plant is derived from wells in the vicinity that have been drilled to the water horizon in the Rustler formation, at approximately 240 ft. depth. There are four producing wells, varying in depth from 167 to 242 ft. and yielding 190, 270, 375, and 1,080 g.p.m. respectively. The last-mentioned flow is from the latest well to be drilled and is the volume noted after 48 hr. continuous running. These wells are 15-in. (churn-drill) holes with 12½-in. casing. They are equipped with deep-well pumps, respectively, one Byron-Jackson, two Pomonas, and one Worthington. Four other wells have been drilled, but they either are not productive or are not used.

Of the remaining buildings of the surface plant the machine shop and the adjacent stores building present an interesting combination to the eye. As one of the photographs shows, the two are linked together by a canopy at their front ends under which the supports of the traveling crane of the stores building continue across the intervening space so that the crane can deliver materials to the shop where the shop crane can pick them up.

27. One of the two box-car loaders

28. Train load of potash salts from Union refinery. This was the first shipment made



Looking across main analytical room of laboratory. An adjacent picture shows the building exterior

The stores building was built by Patterson Steel Co. and the shop by Mosher Steel Co. Both buildings are covered with 22-gage galvanized iron. The shop has a 20-ton traveling crane of the Armington Engineering Co., Euclid, Ohio, and, besides a grinding wheel and a drill press, its principal piece of equipment is a rather large American Tool Works lathe, 30 ft. by 30 in. in size and powered with a 20-hp. motor. This building, as are most of the others, is heated as needed with wall-type, natural-gas-fired heaters of Carrier and other makes. A carpenter shop in a wood frame building covered with corrugated iron adjoining the machine shop boasts a planer and a saw.

The warehouse, a steel-frame building also erected by Patterson and covered with 22-gage galvanized iron, is equipped with a 1-ton Peerless crane.

In a corner of the building housing the main hoist that has already been mentioned in the description of the No. 1 shaft and its equipment, are three racks for charging the batteries of the miners' electric cap lamps.

The company's office is close to the gate. Here the general manager, Harold S. Martin, makes his headquarters and the various department heads have their offices. The building also houses the engineering and accounting departments.

Behind the office is situated a laboratory, of similar architecture, housing a sample preparation room, analytical laboratory, and facilities for chemical and metallurgical research as well as a technical library.

The analytical work is done in a spacious 28x30-ft. room fitted to handle both shipments analyzed by the official Lindo-Gladding method as well as plant control samples estimated by the faster Sherrill centrifugal determination. This room is kept at a 75 deg. F. constant.

The building's equipment, modern in design, is specially adapted to problems dealing with the single and double salts of potassium and magnesium.

Comfortable residences for four of the key members of the staff—namely the mine foreman, master mechanic, assistant master mechanic, and the power house foreman—have been erected close to the plant. Aside from these individuals all of the staff members and office force reside in Carlsbad, 26½ miles away by road, using company cars or their own for the daily trip back and forth. Most of the shift workers also live in Carlsbad and make the journey either in their own automobiles or in buses. A regular service between the town and plant is maintained by a private bus company, part of the expense being borne by the Union company.

The new enterprise of Union Potash & Chemical Co. comes upon the scene at a critical time when, with foreign supplies of potash again cut off, it can aid in meeting the country's requirements as to this important mineral. In the remarkably rapid development of its mine to the point of production and provision of adequate plant and processes for the treatment of its ores, the company and its staff have scored a real achievement. In its current research program, moreover, the company looks ahead. In particular it is giving serious attention to the fact that the waste liquor from its sulphate plant contains some 18 percent of magnesium chloride. The recovery at a not-too-distant date of this magnesium as metal is within the realm of possibilities.

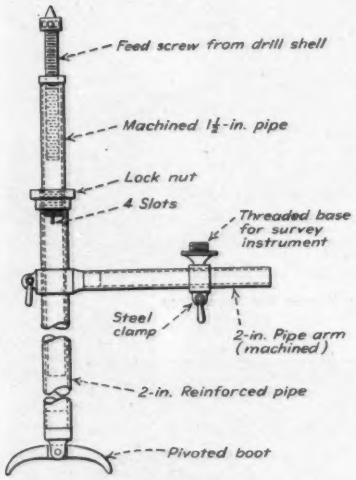
Exterior of the building that houses the laboratory

Warehouse or stores building, left, and the machine shop adjoining it. A crane runway beneath the connecting canopy permits delivery of supplies directly to the shop door

USEFUL OPERATING IDEAS

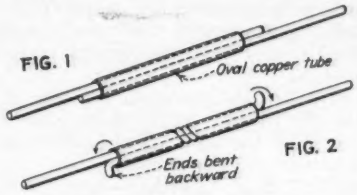
Support for Transit

ALTHOUGH use of the conventional tripod is satisfactory in surface surveying operations, it is fraught with numerous hazards underground. For instance, when working in drifts given over to haulage, work proceeds slowly because of interruptions, apart from the danger of the instrument being knocked down accidentally and perhaps broken. Limited range is another disadvantage. Realizing these handicaps, and wishing to make underground surveying safer and more rapid, J. Schober, manager, Tennessee-Schuylkill Corporation, Chloride, Ariz., developed and had constructed the novel and relatively inexpensive instrument support explained in detail in the accompanying sketch. It consists essentially of a circular steel column made from reinforced 2-in. pipe, with a pivoted boot at the lower end, a short length of 1¼-in. pipe machined on the outside and containing a setscrew arrangement consisting of an old drill-shed feed screw, and a movable side arm made from 2-in. pipe with an adjustable threaded base for the instrument proper. The device can be used in drifts, raises, and other underground workings. It has about 18 in. more range than the conventional tripod, cannot be knocked down, and when employed in drifts can be set up so as not to interfere with tramming, the mine cars passing under the side arm, or the side arm being swung back if set at a low point. All parts were made from scrap materials at the mine machine shop at a moderate cost.



Simple Wire Joint

MINE ELECTRICIANS often are called upon to repair broken electric contacts quickly to restore light and power service underground or on surface. In mines where gas is frequently met care must be exercised to provide a tight joint to prevent subsequent sparking and possible rupture. A simple wire joint guaranteed to give good electrical contact without having to resort either to complicated mechanical arrangements or to use of solder, and one that cannot be pulled apart, is explained in a sketch.



The only material needed to make the joint is a short length of soft copper tubing. To secure good electrical contact, the tube, which in most cases is 3 to 4 in. long, should be of such size that the two wires to be jointed will nearly fill it. The method of procedure is as follows: After slipping the two wires through the tube hammered slightly oval (Fig. 1) and bending the ends of the wires backward (Fig. 2), each end of the tube is given a turn or two in opposite directions by means of two pairs of pliers. The soft tube as a consequence will bend to the shape of the joint and fill up the interstices with a close metal-to-metal grip.

▼

All-welded Dipper Stands Abuse

A MISFIRED dynamite charge was set off by being struck by a power-shovel dipper, writes Paul C. Ziemke, of Milwaukee. The force of the explosion was apparently localized directly under the bail hinge (facing the shovel), because the bail was twisted and a break noted in the weld between the shell and the lip on the left side. This weld demonstrated its superior qualities by reason of having failed only after the lip had been twisted 2½ in. out of line. The dipper proper was forced approximately 7½ in. off square, and the manganese steel lip was bent fully 2½ in. Also, one tooth insert was cracked.

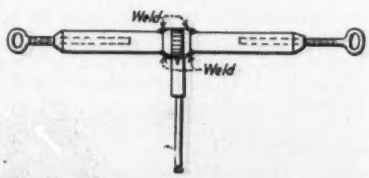
The new all-welded steel type of construction had withstood the unusual abuse remarkably well, because there were no cracks in either the dipper door or shell other than those between lip and shell.

After the process of heating and forcing the dipper into shape with hydraulic jacks had been completed, arc welding completed the repair job. All welds were stressed relieved locally. The expense involved allowed a saving of 40 per cent over the first cost of a new dipper.

▼

Rachet Turnbuckle

IN HANGING TROLLEY WIRE and feeder lines, a ratchet-type turnbuckle is described as a great time saver by E. P. McFarland, chief electrician of a mine at Clairfield, Tenn. He made this tool by cutting in two a regular turnbuckle and welding the two parts to an old track ratchet. In one instance 1,700 ft. of 500,000-circ. mil feeder was stretched at one time with the turnbuckle. The ratchet is double acting, and therefore can be reversed for release after a trolley switch, section insulator, splice, or dead end has been installed.



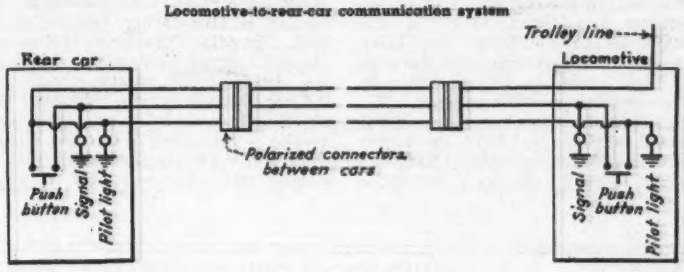
Body cut in two and welded to a ratchet

Trip-Length Communication Makes for Safety

TO PERMIT two-way communication between motorman and brakeman on 16- to 20-car trips hauled by a 13-ton locomotive, cars at a Western mine are fitted with three-conductor cables and Miller polarized connectors. As long as there is power on the locomotive and the circuit is complete, the arrangement enables the brakeman at the rear to signal the motorman regardless of noise and even though the trip is rounding a curve.

The station at each end consists of a pushbutton, red signal lamp, and pilot lamp. Both pilot lamps burn all the time to show that the circuit from locomotive to last car is complete and that the rear-car signal station is connected. Signal lamps at both ends flash when either button is pushed. Additional investment in material and bulbs and the time required to plug together the connectors between cars are the disadvantages which weigh against the safety and flexibility afforded by the system.

Locomotive-to-rear-car communication system



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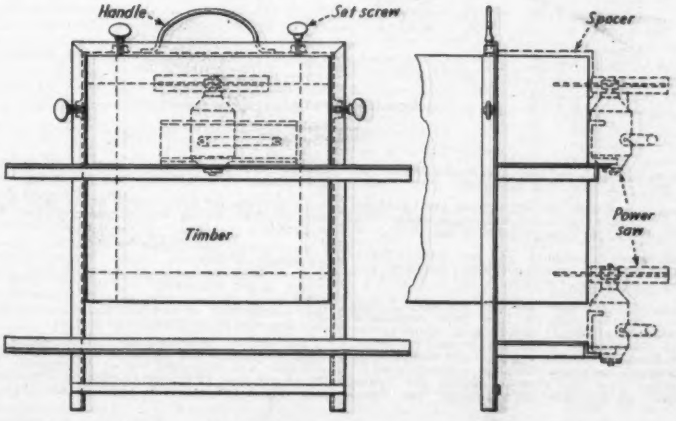
Jig for Timber Framing

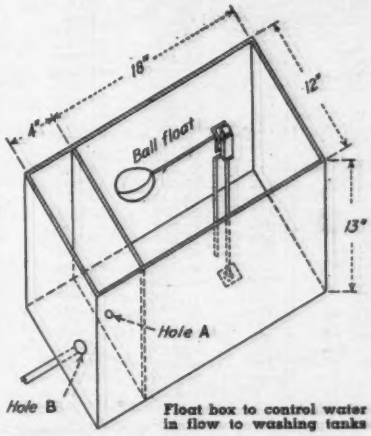
AN INTERESTING FEATURE at the timber shop of United Verde Branch, Phelps Dodge Corporation, Jerome, Ariz., is the rapid framing of mine timbers by hand, use being made of a small portable power saw and the simple jig explained in detail in the accompanying sketch. The jig was developed by M. Amersek, and essentially consists of a rectangular frame and two guides, all made from angle iron, and welded. Auxiliary parts on the frame to facilitate alignment of the jig and subsequent retention include a handle made from round mild steel, and four setscrews.

The jig is simple to use. It is slipped over the timber to be framed, then quickly aligned with the aid of a wooden spacer resembling a try-square, and finally secured tightly to the timber by adjustment of the four setscrews. Next, the power saw is placed on the upper steel guide and slowly moved across the end of the timber, which operation is later repeated on the lower guide. After both cuts have been completed, the jig is removed, the timber resting on two special carpenter's horses turned to the required position, the jig realigned, and the aforedescribed operations repeated. The top cuts on the timber are made by the power saw without the aid of the jig.



Float Box for Test Work

VARIOUS CHANGES destroyed the uniformity of water pressure formerly maintained by an Atwood-Morrell controller at a small mill, writes K. M. Banthin, of Oak Park, Ill. At the laboratory where experimental ore-washing tests were being run, the variation in pressure gave misleading results. It was decided to control the quantity of water only at such points in the circuit where this was necessary for comparative results. This control was effected by constructing float boxes as shown. The float maintained a constant head of water in each box with the outflow controlled by the size of hole *A*. The box was set up near the launder and connected to it by a short piece of hose from hole *B*. To calibrate or check the flow, this hose was put into a 5-gal. bottle or 15-gal. drum and the outflow was measured with a stop-watch. The flow was readily increased by reaming out hole *A* or was decreased by plugging the hole with a rubber cork of proper size. The boxes were made by the mill welder at an outlay for material of $1.50.



Float box to control water in flow to washing tanks

Five Dollars Easily Earned

HOW MANY TIMES have you ironed out a kink in electrical maintenance practices? How many times have you short-cut an old shop method to save hours of work? How many times have you studied an operating problem and licked it, to the satisfaction of yourself and your boss? *E.&M.J.* pays a five dollar minimum for all operating ideas accepted for publication. Just sketch it, or photograph it, and describe it in sufficient detail to give the complete idea, then send it in. Our readers want them and we gladly pay the price for them. May we have your "Idea" now?

Summary of the

MARKETS

CONSUMPTION of non-ferrous metals during March continued at the same high rate as in the two preceding months. Additional restrictions were imposed on the industry during the last month, in that mandatory priorities were established on nickel, magnesium, and tungsten products. Producers of zinc agreed to set aside 5 percent of their total production for a "pool" to supply the metal to those in need of zinc against urgent defense orders. Ceiling prices on scrap and secondary aluminum and zinc were posted. As the month ended the authorities in Washington were investigating scrap and secondary copper and brass, as well as brass ingots. A strong price warning on quicksilver revealed that production here has increased to about 40,000 flasks a year, and, in the opinion of the price-stabilizing division of NDAC, a real shortage in supplies does not exist. Lead, cadmium, beryllium, and titanium have been added to the products on which export licenses are required.

The *E.&M.J.* price index for March advanced slightly to 83.17 on higher monthly averages for copper, lead, and tin. The index for February was 82.76.

Sales of copper to domestic consumers during March amounted to 75,984 tons, against 88,607 tons in February. The Metals Reserve Company released about 30,000 tons of foreign origin "stockpile" copper to domestic consumers during March. Apparent consumption of copper in this country is estimated at 125,000 tons a month. Large mine operators held to 12c. a pound, Valley, with custom smelters and some small producers sellers at 12¼c. Export copper was higher on reduced offerings of metal not under contract to Metals Reserve.

Lead advanced 20 points under continued active buying. Except for uncertainty about price policy in Washington, the trade felt that quotations would have risen to well above 6c. The buying is stimulating imports of pig lead. The price situation in zinc was unchanged. Production of zinc is increasing, but supplies remain tight. Non-defense industries are reducing their zinc requirements. Use of cadmium for plating is expanding. Increased shipping rates were reflected in higher prices for chrome and manganese ores.

UNITED STATES MARKET

1941	Electrolytic Copper: Domestic (a) Refinery	Electrolytic Copper: Export (b) Refinery	Straits Tin: New York	Lead: New York	Lead: St. Louis	Zinc: St. Louis
Mar.						
1	11.775	10.475	51.250	5.65	5.50	7.25
3	11.775	10.450	51.250	5.75	5.50@5.60	7.25
4	11.775	10.450	51.250	5.75	5.60	7.25
5	11.775	10.450	51.250	5.75	5.60	7.25
6	11.825	10.450	51.375	5.75	5.60	7.25
7	11.775	10.450	51.625	5.75	5.60	7.25
8	11.775	10.450	51.750	5.75	5.60	7.25
10	11.775	10.450	52.000	5.75	5.60	7.25
11	11.800	10.500	51.750	5.75	5.60	7.25
12	11.775	10.450	51.875	5.75	5.60	7.25
13	11.875	10.550	52.000	5.75	5.60	7.25
14	11.825	10.550	52.000	5.75	5.60	7.25
15	11.825	10.550	52.125	5.75	5.60	7.25
17	11.775	10.600	52.125	5.75	5.60	7.25
18	11.875	10.600	52.250	5.75	5.60	7.25
19	11.800	10.600	52.375	5.75	5.60	7.25
20	11.825	10.700	52.750	5.75	5.60	7.25
21	11.950	10.700	52.500	5.75	5.60	7.25
22	11.775	10.825	52.500	5.75	5.60	7.25
24	11.800	10.825	52.500	5.75	5.60	7.25
25	11.825	10.700	52.500	5.75	5.60	7.25
26	11.850	10.575	52.625	5.85	5.70	7.25
27	11.850	10.700	52.625	5.85	5.70	7.25
28	11.875	10.825	52.750	5.85	5.70	7.25
29	11.800	10.825	52.625	5.85	5.70	7.25
31	11.825	10.700	52.125	5.85	5.70	7.25
			AVERAGES FOR MONTH			
Mar.	11.814	10.592	52.067	5.765	5.613	7.250
Mar.			AVERAGES FOR WEEK			
5	11.775	10.454	51.238	5.700	5.542	7.250
12	11.788	10.458	51.729	5.750	5.600	7.250
19	11.829	10.575	52.146	5.750	5.600	7.250
26	11.838	10.721	52.563	5.767	5.617	7.250
Mar.			CALENDAR WEEK AVERAGES			
1	11.804	10.433	51.696	5.650	5.500	7.250
8	11.783	10.450	51.417	5.750	5.592	7.250
15	11.813	10.508	51.958	5.750	5.600	7.250
22	11.833	10.671	52.417	5.750	5.600	7.250
29	11.833	10.742	52.604	5.817	5.667	7.250

SILVER, GOLD AND STERLING EXCHANGE

1941	Sterling Exchange: "Checks" (Nominal)	Sterling Exchange: "90-day demand"	Silver (c): New York	Silver (c): London	Gold: London	Gold (d): United States
Mar.						
1	402.000	(f)	(e)	(e)	(e)	$35.00
3	402.000	(f)	34.750	23.3125	168s	35.00
4	402.000	(f)	34.750	23.3750	168s	35.00
5	402.000	(f)	34.750	23.3750	168s	35.00
6	402.000	(f)	34.750	23.3750	168s	35.00
7	402.000	(f)	34.750	23.3750	168s	35.00
8	402.000	(f)	(e)	(e)	(e)	35.00
10	401.500	(f)	34.750	23.3750	168s	35.00
11	402.000	(f)	34.750	23.3750	168s	35.00
12	401.500	(f)	34.750	23.4375	168s	35.00
13	402.000	(f)	34.750	23.4375	168s	35.00
14	401.500	(f)	34.750	23.5000	168s	35.00
15	402.000	(f)	(e)	(e)	(e)	35.00
17	402.000	(f)	34.750	23.5000	168s	35.00
18	401.500	(f)	34.750	23.5000	168s	35.00
19	401.500	(f)	34.750	23.5000	168s	35.00
20	402.000	(f)	34.750	23.5000	168s	35.00
21	401.500	(f)	34.750	23.4375	168s	35.00
22	402.000	(f)	(e)	(e)	(e)	35.00
24	402.000	(f)	34.750	23.5000	168s	35.00
25	402.000	(f)	34.750	23.5000	168s	35.00
26	401.500	(f)	34.750	23.5000	168s	35.00
27	401.500	(f)	34.750	23.5000	168s	35.00
28	401.500	(f)	34.750	23.5000	168s	35.00
29	401.500	(f)	(e)	(e)	(e)	35.00
31	401.500	(f)	34.750	23.500	168s	35.00
			AVERAGES FOR MONTH			
Mar.	401.788	.....	34.750	23.446	....	35.00
Mar.			AVERAGES FOR WEEK			
5	402.000	.....	34.750	.....	....	.....
12	401.833	.....	34.750	.....	....	.....
19	401.750	.....	34.750	.....	....	.....
26	401.833	.....	34.750	.....	....	.....

Calendar week averages, New York Silver: March 1st, 34.750; 8th, 34.750; 15th, 34.750; 22nd, 34.750; 29th, 34.750.

(e) Not quoted (Saturday). (f) No quotations.

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Owing to the European War and the disruption of normal trade relations, our export copper quotations, since September, 1939, have been based largely on f.a.s. transactions, ex United States ports. To arrive at the f.o.b. refinery quotations deduct .05 from the f.a.s. basis for lighterage.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade Zinc delivered in the East and Middle West in nearly all instances command a premium of 1c per pound over the current market for Prime Western but not less than 1c over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly-mined domestic, by Handy & Harman. Under Treasury order of July 6, 1939, the price on domestic newly-mined silver mined subsequent to July 1, 1939, was fixed at 71.11c per troy ounce. Handy & Harman's quotation on newly-mined domestic silver, 999 fine was 70⅝c throughout March.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125.

LONDON MARKET

March, 1941	Tin Standard Spot	Tin Standard 3 months
3	264.0000	263.7500
4	265.0000	264.0000
5	266.5000	266.2500
6	266.0000	266.0000
7	267.0000	266.2500
10	269.0000	268.2500
11	268.2500	267.0000
12	269.0000	266.5000
13	269.0000	267.0000
14	269.2500	267.5000
17	272.0000	269.7500
18	271.2500	269.0000
19	272.0000	270.7500
20	272.5000	270.7500
21	273.0000	270.7500
24	272.2500	270.0000
25	273.2500	270.5000
26	273.2500	270.2500
27	273.7500	271.0000
28	274.0000	271.0000
31	272.5000	269.2500
Average	270.131	.....

Official tin prices on London Metal Exchange in long tons, pound sterling. Trading in copper, lead, and zinc suspended August 31, 1939.

Weekly MARKET INFORMATION Service

- E&MJ Metal & Mineral Markets, the weekly price information service of Engineering & Mining Journal, will keep you in close touch with effects of war developments on costs and availability of metals and non-metallic minerals.
- Printed and mailed every Wednesday night, E&MJ Metal & Mineral Markets will speed to you as special newspaper mail. It carries daily and weekly average prices of metals for the preceding six market days.
- Rates: $5 a year in the United States and possessions, and in the Americas; $10 a year elsewhere. Address:

E&MJ METAL & MINERAL MARKETS

Dept. 101 330 West 42nd Street New York, N. Y.

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(April 1, 1941)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	17c.
Antimony, domestic, spot, lb	14.00c.
Bismuth, ton lots, lb	$1.25
Cadmium, commercial sticks, lb	85c.
Calcium, lb., ton lots 97 @ 98 per cent	Nominal
Chromium, 97 per cent grade, lb	89c.
Cobalt, 97 to 99 per cent, per lb	$1.50
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	27c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$36.00
Quicksilver, flask of 76 lb., 100 flasks or more	$181.00
Radium, mg. radium content	$25.00@$30.00
Selenium, 99.5 per cent, lb	$1.75
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75
Thallium, 100 lb. or more, lb	$10.00
Titanium, 96 to 98 per cent, lb	$5.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 48 @ 50% Cr_2O_3 c.i.f. Atl. ports, long ton	(b)$40.00@$41.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$4.75
Mesabi bessemer	$4.60
Old Range non-bessemer	$4.60
Mesabi, non-bessemer	$4.45
Lead (Galena) 80 per cent, Joplin, Mo., ton	$69.58
Manganese Ore, (foreign) c.i.f. U.S. ports, long ton unit of Mn:	
52 @ 55 per cent	(b) 70c.
50 @ 52 per cent	(b) 70c.
46 @ 48 per cent	(b) 65c.
Molybdenum Ore, 90%, per lb. of MoS_2, f.o.b. mines	45c.
Tungsten Ore, per unit of WO_3:	
Chinese, 65 per cent, duty paid	(b) $24.00
Domestic, 65 per cent and upward	(a) $23.50
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton	$48.00

(a) Prices at mines, small lots, usually several dollars less. (b) Nominal.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	3½c
Cobalt Oxide, 70 @ 71 per cent, lb	$1.84
Copper Sulphate, 100 lb	$4.75
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.42
Sodium Sulphate, bulk ton	$18.00@$22.00

ALLOYS

Beryllium Copper, master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$15.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, per pound of Cr contained	11c.
Ferromanganese, 78 @ 82 per cent, gross ton	$120.00
Ferromolybdenum 55 @ 65 per cent Mo. lb. of Mo. contained	95c.
Ferrosilicon, 50 percent, gross ton	$74.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$1.90@$2.00
Ferrovanadium, per lb. of V, delivered	$2.70@$2.90

NON-METALLIC MINERALS

Asbestos, f.o.b. mines (U.S. funds), ton:	
Canadian (Quebec)	
Crude No. 1	$700@$750
Crude No. 2	$150@$350
Spinning fibers	$110@$200
Paper stock	$40@$49
Shorts	$13@$17.50
Vermont	
Shingle stock	$57
Paper stock	$40
Cement stock	$25
Barytes, long ton:	
Georgia, crude	$8.00
Missouri, 93 per cent $BaSO_4$, less than 1 per cent iron	$5.00@$6.50
Bauxite, long ton:	
Domestic, chemical, 55 @ 58 per cent	$7.00@$8.00
Domestic, abrasive, 80 @ 84 per cent	$14.00
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$5.75@$8.00
Delaware, No. 1	$14.50
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$20.00
Ground, 95 @ 98 percent, bulk, ton	$31.00
Lump, acid, 98 percent, bulk, ton	$27.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00
Dead-burned, f.o.b. Washington	$22.00
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in.	45@60c.
2 x 2 in.	60@80c.
3 x 3 in.	$1.25@$1.50
3 x 4 in.	$1.50@$1.75
3 x 5 in.	$1.75@$2.25
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12c.
Silica, in bags, 325 mesh, ton	$20.00@$40.00
Sulphur, Texas, mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.50@$10.50
Vermont, extra white, 200 mesh	$9.50@$10.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$14.50
200 mesh, cream colored	$26.00

(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$24.50
Basic	$23.50
No. 2 Foundry	$24.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$34.00
Structural shapes, 100 lb	$3.10
Bars, 100 lb	$3.15

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1940	1941	1940	1941	1940	1941
January	34.750	34.750	21.892	23.273	395.442	(a) 402.000
February	34.750	34.750	20.935	23.341	395.652	(a) 401.804
March	34.750	34.750	20.763	23.446	375.212	(a) 401.788
April	34.750	.....	20.713	.....	351.817	.....
May	34.949	.....	21.878	.....	326.452	.....
June	34.825	.....	22.688	.....	359.560	.....
July	34.750	.....	22.095	.....	379.750	.....
August	34.750	.....	23.261	.....	396.889	.....
September	34.750	.....	23.446	.....	401.646	.....
October	34.750	.....	23.451	.....	401.692	.....
November	34.750	.....	23.238	.....	401.783	.....
December	34.750	.....	23.015	.....	402.000	.....
Year	34.773	.....	22.281	.....	382.325	.....

New York quotations for silver other than newly-minded domestic, cents per ounce troy, 999 fine, London pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents. (a) Nominal.

COPPER

	F.O.B. Refinery, Electrolytic			
	Domestic		Export	
	1940	1941	1940	1941
January	11.954	11.819	11.999	10.257
February	11.148	11.794	11.471	10.414
March	11.160	11.814	11.407	10.592
April	11.087	.....	11.258	.....
May	11.079	.....	11.191	.....
June	11.128	.....	11.216	.....
July	10.564	.....	10.189	.....
August	10.708	.....	9.851	.....
September	11.296	.....	9.849	.....
October	11.826	.....	10.436	.....
November	11.800	.....	10.084	.....
December	11.802	.....	10.293	.....
Year	11.296	.....	10.770	.....

New York quotations, cents per pound.

LEAD

	New York		St. Louis	
	1940	1941	1940	1941
January	5.471	5.500	5.321	5.350
February	5.076	5.602	4.926	5.452
March	5.192	5.765	5.042	5.613
April	5.071	.....	4.921	.....
May	5.015	.....	4.865	.....
June	5.000	.....	4.850	.....
July	5.000	.....	4.850	.....
August	4.854	.....	4.704	.....
September	4.929	.....	4.779	.....
October	5.308	.....	5.158	.....
November	5.726	.....	5.578	.....
December	5.500	.....	5.350	.....
Year	5.179	.....	5.029	.....

New York and St. Louis quotations, cents per pound.

TIN

	Straits New York		Standard, Spot London	
	1940	1941	1940	1941
January	46.707	50.154	240.716	256.648
February	45.851	51.293	242.833	264.975
March	47.079	52.067	251.711	270.131
April	46.815	.....	252.080	.....
May	51.570	.....	264.098	.....
June	54.618	.....	273.438	.....
July	51.591	.....	265.592	.....
August	51.176	.....	262.455	.....
September	50.348	.....	251.024	.....
October	51.490	.....	257.946	.....
November	50.577	.....	258.214	.....
December	50.101	.....	256.988	.....
Year	49.827	.....	256.425	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		
	1939	1940	1941
January	4.500	5.644	7.250
February	4.500	5.534	7.250
March	4.500	5.750	7.250
April	4.500	5.750	.....
May	4.500	5.803	.....
June	4.500	6.235	.....
July	4.518	6.250	.....
August	4.719	6.389	.....
September	6.104	6.920	.....
October	6.500	7.250	.....
November	6.500	7.250	.....
December	5.980	7.250	.....
Year	5.110	6.335	.....

St. Louis quotations, Prime Western, cents per pound.

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1940 (a)	1941 (a)	1940	1941
January	79.038	80.000	20.000	17.000
February	80.000	82.273	20.000	17.000
March	80.000	89.038	19.769	17.000
April	80.000	.....	19.000	.....
May	80.000	.....	19.000	.....
June	80.000	.....	19.000	.....
July	80.000	.....	19.000	.....
August	80.000	.....	18.000	.....
September	80.000	.....	18.000	.....
October	80.000	.....	18.000	.....
November	80.000	.....	17.522	.....
December	80.000	.....	17.000	.....
Year	79.920	.....	18.691	.....

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound. (a) Producers' price, commercial sticks.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1940	1941	1940	1941	1940	1941
January	14.000	14.000	156.962	165.846	40.000	36.000
February	14.000	14.000	178.000	170.182	40.000	36.000
March	14.000	14.000	180.921	177.692	40.000	36.000
April	14.000	.....	173.538	.....	38.923	.....
May	14.000	.....	181.538	.....	38.000	.....
June	14.000	.....	197.360	.....	38.000	.....
July	14.000	.....	194.423	.....	38.000	.....
August	14.000	.....	184.111	.....	38.000	.....
September	14.000	.....	173.333	.....	36.167	.....
October	14.000	.....	168.846	.....	36.000	.....
November	14.000	.....	168.391	.....	36.000	.....
December	14.000	.....	164.960	.....	36.000	.....
Year	14.000	.....	176.865	.....	37.924	.....

(a) Antimony, cents per pound, ordinary brands, in cases; in bulk f.o.b. Laredo, Tex., 13.000 for February. (b) Quicksilver, dollars per flask of 76 lb. (c) Platinum, per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1940	1941	1940	1941	1940	1941
January	23.50	24.50	22.50	23.50	23.00	24.000
February	23.50	24.50	22.50	23.50	23.00	24.000
March	23.50	24.50	22.50	23.50	23.00	24.000
April	23.50	.....	22.50	.....	23.00	.....
May	23.50	.....	22.50	.....	23.00	.....
June	23.50	.....	22.50	.....	23.00	.....
July	23.50	.....	22.50	.....	23.00	.....
August	23.50	.....	22.50	.....	23.00	.....
September	23.50	.....	22.50	.....	23.00	.....
October	23.50	.....	22.50	.....	23.00	.....
November	23.50	.....	22.50	.....	23.00	.....
December	23.50	.....	22.50	.....	23.00	.....
Year	23.500	.....	22.500	.....	23.000	.....

Iron, dollars per long ton. F.o.b. Mahoning and Chenango Valley furnaces.

PERSONAL ITEMS

W. Lee Heidenreich has returned from Bolivia.

W. Earl Greenough, of Mullan, Idaho, has been in New York.

Ralph S. Blitz has removed from Rapid City, S. D., to Naturita, Colo.

J. B. McCardle has returned to the United States from Manila, P. I., and is at Reedley, Calif.

Ben Sheahan, mining geologist, has changed his residence from Bingham, Utah, to Las Vegas, Nev.

J. A. Pike, formerly at the Tombill mine, Geraldton, Ontario, Canada, is now at Island Mountain mines, Wells, B. C.

A. C. Melting recently resigned from his position as general superintendent of Santa Barbara mine, in the Philippines.

Edwin J. Appel has been appointed manager of the new Longview, Wash., aluminum reduction plant of the Reynolds Metals Co.

R. J. Wolf, formerly chief chemist of Golden Queen Mining Co., Mojave, Calif., has joined the staff of the United States Mint in San Francisco.

Dr. Charles H. Behre, Jr., William Deering professor of economic geology at Northwestern University, has been named professor of geology at Columbia.

A. W. Tolonen has left Cie. Aramayo de Mines en Bolivie, La Paz, Bolivia, and is employed in the mill of the Northern Peru Mining & Smelting Co., Trujillo, Peru.

Dale L. Pitt, formerly with Premier Gold Mines, in British Columbia, and Big Bell, in Australia, has been elected president and general manager of Kensington Mines, Inc, Seattle, Wash.

Theodore Thoresen, Jr., has joined the technical staff of the Freeport Sulphur Co. He will make his headquarters at present at the Freeport company's Grand Ecaille mine, at Port Arthur, La.

George F. Zoffman, president and general manager of the Duval Texas Sulphur Co., announces the removal of his offices from the Electric Bldg. to 1120 Niels-Esperson Bldg., Houston, Tex.

George Townsend Harley, who has been assistant mine superintendent of the Union Potash & Chemical Co. at Carlsbad, N. M., has been promoted to be general superintendent under Harold S. Martin, manager. In his new capacity Mr. Harley will have charge of the operating departments.

J. H. Farrell, mining engineer and geologist, Reno, Nev., corrects an erroneous personal item that appeared in our issue for February. He was in charge of development at the Standard Mine until the latter part of 1937, but has had no connection with the operation since the Standard Cyaniding Co. took over the property. He has not joined the staff of the Twin Buttes Syndicate, but has been employed by that organization from time to time as a consultant. *E.&M.J.*, regrets the publication of the erroneous item.

Dr. Wilbert G. McBride, head of the department of mining engineering at McGill University, at Montreal, and long prominent in the mining circles of

DR. WILBUR G. McBRIDE

Canada, and formerly in those of the United States as well, has been elected president of the Canadian Institute of Mining and Metallurgy.

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OBITUARY

Ernest F. Moore, mining engineer, died at Santa Monica, Calif., on March 10, at the age of 61.

George Fuerman, long prominent in the mining circles of Nevada, died at Reno, in that State, on Feb. 28, 1941, at the age of 58.

George Emerson White, a prominent mining engineer of Los Angeles, died on March 22 at San Marino, Calif, at the age of 55.

Marcus L. Hurley, consulting mining engineer, who was a graduate of the Columbia School of Mines in the class of 1908, died in New York City on March 29. An appreciation will be published in the May issue.

Thomas William Gibson, Deputy Minister of Mines for Ontario from 1906 to 1935, died on Jan. 20 in Toronto at the age of 82.

Richard William Bullard, 79, a pioneer mining man of Congress, Ariz., died on March 10 last. He was owner, at the time of his death, of the Bullard, the Little Giant, and the Cunningham Pass mines, all near Congress.

Dr. Frederick William Simonds, a distinguished geologist and the oldest member of the faculty of the University of Texas, in which he had taught for 51 years, died on March 27 at Austin, Tex., at the age of 87.

Dr. William Lawton Goodwin, founder of the School of Mining at Queen's University, at Kingston, Ont., educator, author, and a leading figure among Canadian scientists for many years, died at Westmount, Toronto, on Jan. 17, 1941, at the age of 85.

Ernest M. Koetting, well known in the West as a drill operator and who had been engaged in drilling work on the Canal Zone since March, 1940, died on March 20 at Ancon, C. Z., at the age of 45. He had been transferred in February of this year to the Municipal Engineering Division as foreman.

Ing. Luis Gomez Chico, assistant general manager of the Compañia Real del Monte y Pachuca, S. A., Pachuca, Hidalgo, was killed with his cousin, **Lic. Eduardo Chico Ibarguengoitia,** prominent Mexico City lawyer, when a train ran down the automobile they were riding in near Mineral Marfil, Guanajuato, on March 10.

Thomas Henry Jenks, a mining engineer well known and highly esteemed throughout Colorado and the West in general, and for many years a director of mining enterprises and consultant in mining and geology, died in Denver on March 3 at the age of 72. He was a member of many associations and mining fraternities and of the A.I.M.E.

Jerome J. Day, a prominent mining man of northern Idaho, and formerly president of Northport Smelting & Refining Co. before that property was sold to the American Smelting & Refining Co. in 1922, died on March 9 at Phoenix, Ariz., at the age of 64. He had long been identified with mining and smelting in the Northwest and was a director in many corporations operating in the Coeur d'Alene district. He was a member of many clubs and associations as well as of the A.I.M.E.

Alfred Frank Beasley, affectionately known to his friends as "Al," who died in San Francisco on Oct. 25 last at the age of 54, had gone to Southern California accompanied by his wife Ruth about two weeks before, seeking relief from a long illness. He was born Feb. 12, 1886, in Peoria, Ill., and received his technical schooling at Rensselaer Polytechnical Institute, at Troy, N. Y. He began his metallurgical career by joining the staff of the Consolidated Mining & Smelting Co.'s smelter at Trail, B. C., in the fall of 1906, where he continued until April, 1911, when he left to join the staff of the Mason Valley Mines Co. at Thompson, Nev. Here he remained about six years. In 1917 he joined the staff of the Bunker Hill smelter, which was blown in on July 5, seventeen days after his arrival. He was appointed assistant superintendent to the late M. H. Sullivan, and upon the latter's death in February, 1928, succeeded him as super-

intendent. On July 1, 1940, the company assigned broader responsibilities to the plant superintendent, and he became general superintendent. He was a member of the A.I.M.E., having joined the Institute in 1918. Mr. Beasley attained a high position in the metallurgical profession and was valued as a friend by all who knew him and had his confidence. He is survived by his wife and two sons, Jules and Alfred G., Jr.

W. EARL GREENOUGH

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LETTERS

GOLD

Opinions Differ as to Its Future Value

The Editor:

AT THE RISK of being labeled a conservative die-hard, may I take up the cudgels against your correspondent who contributed the annual review article on Gold to your February issue. The suggestion he makes that the United States deliberately take steps to render worthless its stock of 22 billion dollars in gold in order to discommode a victorious Germany possessing two billions of the same commodity is certainly the prime example of cutting off one's own nose that has come to my attention in a long time.

Without venturing to contradict many of his rather rash assumptions and predictions, I think perhaps the record should be set straight on one important point. Regardless of who wins the war, the fact remains that the economic well-being of a large part of Africa, of the Soviet Union, and even of the tottering business structure of the Japanese Empire, depends on gold mining. Any victor who controls those areas will go cautiously about the matter of devaluing gold if for no other reason than that he will cause vast unemployment. Similarly, in relation to population and economic resources, the people of Australia, Canada, Mexico, Colombia, Peru, and Chile have as great a stake in gold as have we. Your correspondent includes in his review the statement that "the possibility that we would be able to find buyers for our gold is rather remote." When he talks about buyers, I presume he means that we would be paid for our gold in goods. My firm belief is that if we were willing to accept goods in return for gold from any of these countries, they would gladly make the exchange.

The reason that the United States has most of the world's gold is not—as your correspondent naively assumes—that other countries attach no value to gold. The reason that we have it is primarily that venture capital the world over thinks the United States the safest possible refuge. A second and almost equally important reason is that the United States steadfastly refuses to buy from other countries goods and services in an amount equal to the goods and services they are willing to buy from us.

S. D. STRAUSS

New York, N. Y.

The Editor:

IT IS SOMEWHAT DIFFICULT to determine from Mr. Strauss' letter what he considers the major issue between us. I gather, however, that it relates to the policy which should be pursued by the United States in order to prevent its gold stock from becoming worthless.

I am accused of advocating measures that would hasten this result. Since I suggest that the United States might consider abandoning its historic policy of buying gold at a fixed price from all comers, it is presumably this action which Mr. Strauss believes would render our gold stock worthless. In this he *may* be right. But before analyzing our respective positions it is necessary to consider what being "worthless" means when applied to gold.

To some people gold is valuable in itself, it is nice to have around, it has intrinsic qualities which somehow contribute to the financial soundness or the economic well-being of the country which possesses it. Mr. Strauss, like myself, is apparently not of these. The closing sentences of both his second and third paragraphs suggest an impatience with the traditional export surpluses of the United States which should place him among those who would rather have goods than gold. If he does hold this view, he and I must agree that our gold stock will prove worthless if, in the long run, we are unwilling or unable to sell a fair share to foreigners in exchange for goods and services.

Mr. Strauss admits that thus far we have been unwilling to accept goods and services in exchange for gold. In fact, as he points out, our gold accumulation has been due in considerable measure to a contrary economic policy.

There is the possibility, however, that this policy might change, as suggested in my article. But if willing, would we also be *able* to market our gold? It is my opinion, with which Mr. Strauss has expressed unsupported disagreement, that economic necessity will prevent foreign countries generally from taking our gold in exchange for their own goods and services. That the belligerent nations cannot now afford to accumulate gold is clearly evident in the statistics of gold movements to, and merchandise exports from, the United States in recent years of war and war preparation. That these same countries, and most others as well, will be equally unable to acquire substantial amounts of our gold in the years to come is strongly suggested to any one who thinks closely about the probable economic pattern of the post-war world.

If the foregoing appraisal is correct (and it is capable neither of proof nor disproof) the gold hoard of the United States must already be considered worthless so far as the predictable future is concerned; and the country must, therefore, decide whether it will continue to buy unsalable gold. To do so can be justified if the gold is purchased from one's political friends as a practicable means of giving them financial aid; but to purchase gold from one's enemies requires a different justification.

Mr. Strauss does not indicate what his justification for such a policy would be. Reading between the lines, however, he appears to hope that the United States will some day be willing to sell gold for goods; to believe that most foreign countries will be willing and able to buy gold from the United States; and hence to consider that demonetization by foreign countries is all we have to worry about. Preservation of faith in the future of gold, therefore, seems to become the one factor necessary to assure a future market for this country's holdings. To do this we should apparently stand ready now to buy gold from unfriendly countries which, after they have disposed of their holdings, have already indicated that they will have no further interest in the metal.

Mr. Strauss' analysis of the situation (as thus interpreted) cannot be refuted by appeal to facts or logic. It represents an expression of opinion. My own view, however, continues to be that presented in the article: namely, that no action which the United States can take will materially improve or diminish the prospects of disposing of the gold it now has; and that we should, therefore, give careful thought to the question of from whom, and under what circumstances, we shall continue to accumulate further quantities of the metal.

While not, in my view, a major point, I should like to comment in closing on the two following sentences from Mr. Strauss' letter: "Regardless of who wins the war, the fact remains that the economic well-being of a large part of Africa, of the Soviet Union, and even of the tottering business structure of the Japanese Empire depends on gold mining. Any victor who controls those areas will go cautiously about the matter of devaluing gold if for no other reason than that he will cause vast unemployment." In the first place, the Union of South Africa is probably the only country in the world which can be said to be seriously dependent on gold mining for its economic well-being. Gold production is important to Canada and probably to a number of smaller countries, but in no country other than South Africa would inability to sell gold abroad appear to create a major problem. Be that as it may, we may agree that the power or powers in control of the principal gold mining areas will go cautiously about the matter of demonetizing gold. They will do everything within reason to assure a foreign market for the output of their mines. One wonders, however, whether they would be willing to absorb this gold output themselves over an extended period and, in addition, to buy billions of dollars' worth of gold from the United States.

WASHINGTON CORRESPONDENT

To the Editor:

IN THE February Issue of *E.&M.J.* the article on Gold, like many others on that subject of recent appearance, criticizes this nation for "buying gold in unlimited quantities at $35 an ounce from all comers," and fails to suggest any practical alternative except measures possible only under a totalitarian form of government.

Suppose we consider gold as a commodity differing from other commodities in two respects only; first, it is the standard by which the value of other

(*Continued on page* 80)

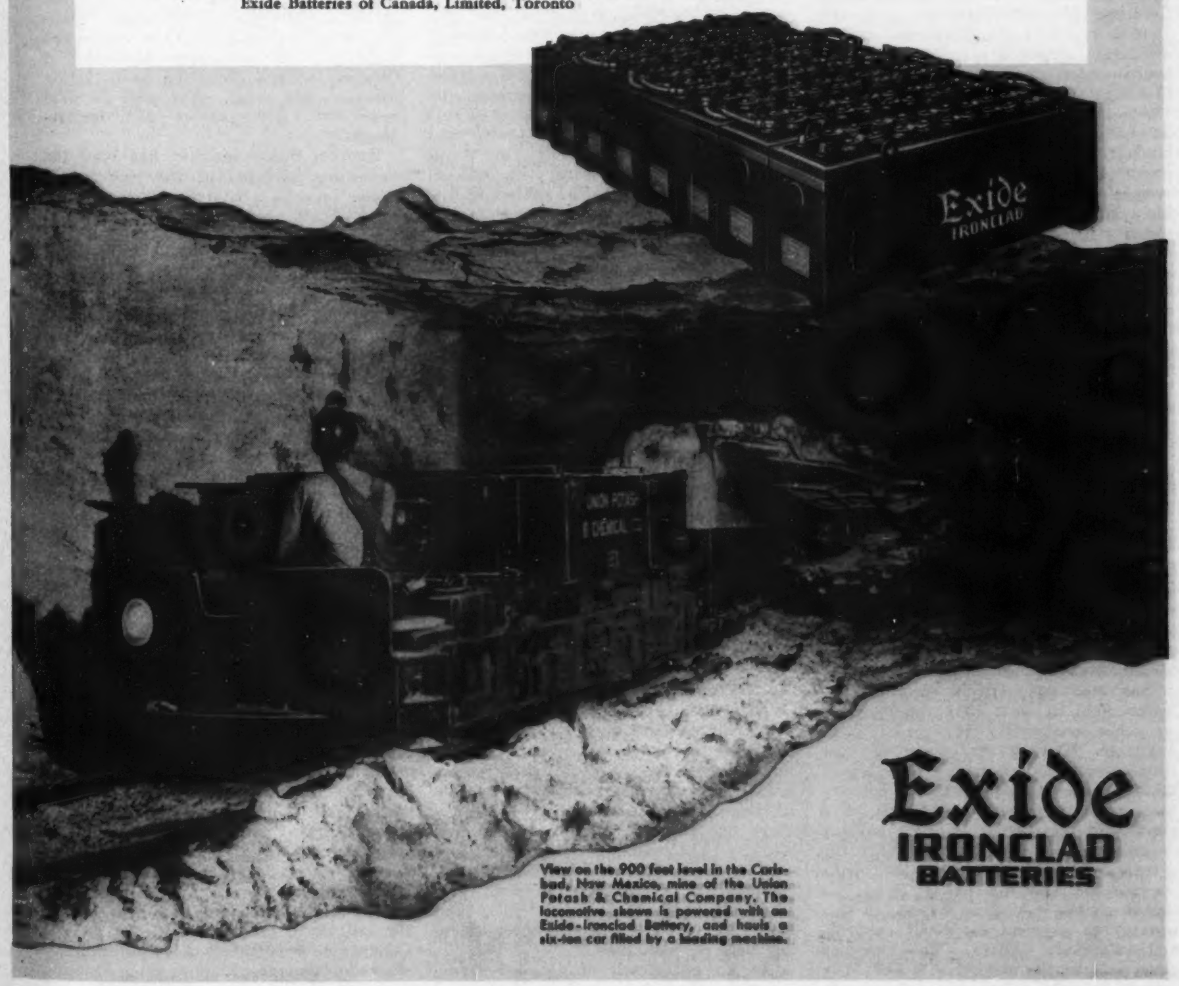
Exide-Ironclad Batteries keep mine cars moving fast . . . for Union Potash & Chemical Company

THE highly mechanized mine of the Union Potash & Chemical Company at Carlsbad, New Mexico, illustrates some of the most important advances recently made in mining equipment. Through the use of a loading machine, and combined shuttle car and mine car haulage, this new potash producer has been able to raise the production level to approximately 2000 tons of crude ore per day.

Two locomotives, each equipped with an Exide-Ironclad Battery, keep the six-ton cars moving as fast as the loading machine fills them. Like other users, this mine finds Exide-Ironclads able to handle such loads with ease and speed, and with unfailing dependability.

It is not only the power a battery delivers, and the haulage speed it provides, but it is faithful, uninterrupted service as well which keeps production curves climbing upward. With an Exide-Ironclad you are sure of all three of these essentials. That is why more Exide-Ironclads are used in locomotive haulage than all other batteries combined. Write for free booklet, "The Storage Battery Locomotive for Underground Haulage."

THE ELECTRIC STORAGE BATTERY CO., Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto



View on the 900 foot level in the Carlsbad, New Mexico, mine of the Union Potash & Chemical Company. The locomotive shown is powered with an Exide-Ironclad Battery, and hauls a six-ton car filled by a loading machine.

Exide
IRONCLAD
BATTERIES

(*Continued from page 78*)
commodities is measured; second, it is used as a basis for national and international credit. In the United States gold is the standard of value because the price of $35 an ounce has been established by decree. With private ownership of gold prohibited, it is obvious that this price could not be maintained unless the Government bought all that was offered at that price. If, in 1930-32, wages and prices in the United States had been allowed to drop back to normal as they have always done heretofore after periods of high prices caused by war, the depression would have ended normally as it did in other countries. But, instead, the expedient of lessening the gold value of the dollar was adopted, which restored the buying power of gold and of the foreign market, but did not restore that of incomes from investments. Thus the buying power of the nation was lowered—doubtless one of the causes of continued unemployment.

In the past the buying power of gold has fluctuated according to supply and demand and the production has increased or diminished with those fluctuations, but the value has changed less than that of most other commodities. The buying power of gold now is practically the same as before the first World War, which is not true of the dollar or other currencies of the world. Gold has been used as a basis for governmental credit for generations and is peculiarly suited for that purpose because a high cost of production results in a high value in a small volume. Other things have been tried to serve as security for government borrowing, such as land for French assignats, but did not prove satisfactory. No government has even succeeded in maintaining its credit for a long period without some tangible security for money borrowed. If a government could borrow money without security, why levy taxes? Gold can be exchanged for goods in practically every country in the world, and this has been true for thousands of years. Is there any other commodity better suited for the purpose for which it is being used?

All domestic and foreign trade consists of the exchange of goods and services. For domestic trade, paper currency answers all requirements, provided this currency can only be acquired in exchange for value received. It is necessary that this proviso be true of the government as well as the people, because when money which has not first been received as taxes or as payment for bonds is issued by a government, it soon becomes worthless. Because the currency of one nation is not acceptable in another, foreign trade must consist purely of an exchange of commodities, and it has been and still is customary to utilize gold in such an exchange when no other commodity is acceptable or available. That is the reason why the United States is acquiring so much gold at this time. Furthermore, any country that excludes imports by means of a tariff wall must accept gold or nothing in exchange for its exports. Since the private ownership of gold has been made illegal, the Government is forced to accept all the gold thus shipped to this country as payment for goods exported and substitute dollars. The currency thus paid to the exporters is obviously based on gold. Nothing could be more illogical than the insistent demand for a high tariff to protect a high wage scale coupled with the demand that the Government cease spending billions of dollars to buy useless gold to bury in a vault.

Prosperity cannot be created, but it can be prevented by law. The law of supply and demand cannot be repealed. Combinations in restraint of trade, such as trusts or closed-shop agreements, cause unemployment and can benefit one group only at the expense of another. A duty on imports is levied at the expense of the exporters. The prosperity of a nation depends upon the volume of its production, and it makes no difference whether the national income is measured in terms of gold or dollars. The gold standard is not to blame for unemployment and an unbalanced budget.

ARTHUR B. FOOTE

Grass Valley, Calif.

Increasing Utility of Mining Geology

The Editor:

MAY I CONGRATULATE *E.&M.J.* and Harrison Schmitt on his excellent "Mining Geology" summary in the February issue. In conjunction with another excellent summary by B. S. Butler in the February issue of *Mining & Metallurgy* we have a good perspective of past accomplishment and unsolved questions. The purpose of this communication is to express thanks and appreciation to Mr. Schmitt, in which, I am sure, many others join, and to add some comments to the subject he discusses. In part these augment Mr. Schmitt's article.

The emphasis in mining geology summaries on hypogene metallic deposits doubtless reflects prevalent interest, but one wonders if the many concerned with other kinds of mineral deposits do not feel neglected. Mr. Schmitt mentions the application of geology to discovery of placer diamond deposits and to discovery of coal seams in Belgium and of potash deposits in southeastern New Mexico, and whets the appetite for fuller treatment of the theory and application of geology to non-hypogene deposits and to the hypogene non-metallic deposits.

One encouraging portent for increased utility of mining geology is the growth of detailed field observations of the past two or three decades. An important job is the correlation and synthesis of these observations. This is being realized and helpful publications are appearing from time to time. But the field is wide and promising and largely undeveloped.

Through mapping and study of lithology and structural geology, high utility of mining geology in particular mines and districts is now generally recognized. However, successful application of these branches of geology is much more prevalent than published records show. In Canada, for instance, such successful application is almost a commonplace. In partnership with geophysical prospecting, such rock and structural studies offer an ever-widening field of usefulness.

As an outgrowth of detailed structural observations in particular districts and correlation with geologic structure over a wide region, highly suggestive features of ore distribution are brought to light. In this, for the United States, Billingsley, Locke, Schmitt, Butler, and many others deserve honorable mention. I suggest that such work, extended widely in many countries, may answer some questions of mineral supply.

But only in so far as ore-forming processes themselves are understood does mining geology promise to reach its full potentialities for usefulness. For the hypogene metallic deposits such understanding constitutes a far more difficult problem than the determination of rock or structural locale of ore. The groping of the past is quite understandable. What of the future?

To me there seem hopeful indications that ideas on ore genesis will increase in utility. One encouragement is the growth in perspective as revealed in such articles as those by Harrison Schmitt and B. S. Butler. The trend among experienced mining geologists is to avoid adherence to well-championed and well-advertised but unsubstantiated hypotheses of ore genesis. One sees a progressive emancipation from the tyranny of retarding hypotheses. Although a number that have had great influence in the past, but frequently violate observation or credulity, still are, or should, be allotted a place in ore deposition, they are not given such undeserved dominance or prevalence as formerly. Observation and deduction or induction therefore are freer. The door is wide open for discrimination and for research.

Another encouragement has been the increasing evidence of the linkage between igneous activity and ore deposition. If it should turn out that ore-forming fluids rise from below the zones in which magmas undergo differentiation, much thought and research based on the premise that ore-forming fluids are a phase of magmatic differentiation will receive a setback. Meantime, observations of association of various kinds of mineral deposits with kinds of igneous rocks is proving a help in the search for ore in certain regions and districts. Actual evidence of magmatic differentiation in which metallic minerals are affected is compelling. Growing appreciation that the source of the magmatically derived ore is usually below (and probably far below) its present position does not seem, *in itself*, to weaken conception of the evolution of the ore-forming fluids from underlying magmas. The place, time, and stage of differentiation into ore-forming fluids; the constitution, phases, localization, and migration in space and time of these fluids; the rock, structural, and other controls on the physico-chemical state and therefore on the precipitation of valuable minerals, and many other matters, are engaging the attention of thousands. Surely, progress will come of this. Indications that ore-forming fluids may migrate great distances, both upward and laterally, from magmatic source, help to explain the position and characteristics of many otherwise enigmatic mineral deposits.

ELLSWORTH Y. DOUGHERTY

Toronto, Canada.

What Metal Statistics Show

AUTHORITIES in Washington have taken action on stabilizing prices for domestic copper, lead, and zinc, aiming in 12c., Valley, for copper, 5.85c., New York, for common lead, and 7¼c., St. Louis, for Prime Western zinc. Given these quotations, domestic producers are moved to appraise the limits of profitable operations, based on the grade of ore in their respective developed and partly developed deposits.

The duty-free copper statistics for March showed a reduction in stocks of refined of 7,816 tons. Blister stocks were down 9,679 tons. The February and March figures of the Copper Institute, in tons, follow:

	Feb.	March
Production:		
Crude (a)	79,240	85,643
Refined	93,654	95,322
Deliveries, refined:		
Domestic	112,808	(b)134,333
Export	11	6
Totals	112,819	134,339
Stocks, refined	97,689	89,873

(a) Corrected. (b) Beginning March, 1941, includes deliveries of duty-paid foreign copper for domestic consumption.

▶LEAD—Stocks of lead refined in this country at the end of February totaled 46,604 tons, a reduction of 644 tons compared with a month previous. Shipments during February amounted to 54,859 tons, which compares with 55,711 tons in January, and 39,176 tons in February last year.

Figures covering lead refined in this country for the months of January and February, in tons, according to the American Bureau of Metal Statistics, follow:

Stock at beginning	40,926	47,248
Production:		
From domestic ore	54,658	47,764
Secondary and foreign	7,390	6,467
Totals	62,048	54,231
Domestic shipments	55,711	54,859
Stock at end	47,248	46,604

A declaration that it may soon be necessary to establish a price ceiling on lead was issued April 5 by Leon Henderson, Commissioner of Price Stabilization. The authorities in Washington believe that the increased demand for lead is due in great part to unnecessary large forward buying and stocking up by consumers. Domestic production, plus available supplies of foreign lead from Mexico, Canada, Australia, and South America, are much more than adequate to meet real consumption at current levels, Mr. Henderson said. In view of this situation, he has requested the leading producers to refrain from further increases in the price.

▶BAUXITE—Domestic production of bauxite in 1940 was the largest since 1923 and imports of the ore were the highest on record, according to preliminary figures compiled by the Bureau of Mines. Production (mine shipments) last year totaled 438,000 long tons (dried-ore basis) and was valued at $2,573,000, an increase of 17 percent in quantity and 19 percent in value compared with 1939.

The mines of Arkansas accounted for 427,000 tons in 1940, against 361,690 tons in 1939 and 293,663 tons in 1938. Production in Alabama, Georgia, and Virginia in 1940 was 11,000 tons, against 13,617 tons in 1939, and 17,253 tons in 1938.

Consumption of bauxite in the United States during 1941 and 1942 should exceed all previous records, the Bureau of Mines states. To meet the requirements of the defense program, production of aluminum is expected to reach an annual rate of 690,000,000 lb. by July 1941 and 825,000,000 lb. by July 1942. At these rates of output, the aluminum industry alone will consume approximately 1,100,000 and 1,300,000 tons of bauxite, respectively.

Total supply of bauxite in the United States in 1940 was 1,067,552 tons, consisting of 438,000 tons from domestic sources and 629,552 tons from abroad. According to the Bureau of Foreign and Domestic Commerce, there were no imports of bauxite from Europe last year. Of the 1940 imports, Surinam furnished 97 percent and British Guiana 3 percent.

Bauxite shipped from mines in the United States and imports for domestic consumption (all figures on dry basis) during the last five years, in long tons, were as follows:

	Domestic	Foreign
1936	380,311	322,790
1937	425,076	507,423
1938	310,916	455,693
1939	375,307	520,179
1940	438,000	629,552

During 1940 the United States exported 81,913 tons of bauxite ore and concentrate, against 51,635 tons in 1939. Most of the bauxite exported went to Canada.

E & M J Weighted Index of Non-Ferrous Metal Prices

(100 is composite for 1922–3–4)

1929	110.33	1935	74.66
1930	82.87	1936	73.45
1931	60.20	1937	90.86
1932	48.26	1938	73.67
1933	39.79	1939	77.71
1934	69.59	1940	79.22

	1939	1940	1941
January	77.12	80.85	82.48
February	76.89	77.23	82.76
March	77.09	77.94	83.17
April	74.79	77.19	....
May	73.61	77.68	....
June	73.17	78.85	....
July	71.95	76.72	....
August	73.88	76.71	....
September	83.07	79.40	....
October	84.23	82.49	....
November	83.80	83.14	....
December	82.89	82.42	....

▶ZINC—The February and March statistics of the American Zinc Institute, covering all grades, are summarized as follows in tons:

	Feb.	March
Stock at beginning	(b) 9,972	(b)7,086
Production	56,334	63,366
Production, daily rate	(b) 2,011	2,044
Shipments(a)	59,220	63,483
Stock at end	(b) 7,086	6,969
Unfilled orders	108,151	97,638

(a) There were no exports of domestic slab zinc during the months of January, February and March. (b) Corrected.

Figures on operations of the Prime Western division alone, for the first three months, follow:

	Production	Shipments	Stock At End
January	(b)26,566	28,209	(b)4,640
February	(b)24,789	26,581	(b)2,848
March	29,077	28,907	3,018

Records of three zinc producers and the American Zinc Institute have been subpoenaed by the anti-trust division of the Department of Justice in search of evidence of illegal trade agreements. The records demanded include foreign correspondence. The companies involved in the exploratory inquiry are the Anaconda Copper Mining Company, the New Jersey Zinc Company, and the American Smelting & Refining Company. Allen A. Dobey, special assistant to the Attorney General, is in charge of the inquiry.

▶MANGANESE—Preliminary annual figures by the Bureau of Mines indicate that domestic production of high-grade metallurgical ore for 1940 amounted to 40,000 long tons, which compares with 29,307 tons in 1939. Manganese ore was reported shipped from Alabama, Arizona, Arkansas, California, Colorado, Georgia, Montana, Nevada, New Mexico, Tennessee, Utah, Virginia, and West Virginia. The states of Arkansas, Montana, and Tennessee accounted for about 80 percent of the total quantity shipped in 1940.

▶MAGNESIUM—Plant capacity to produce magnesium is expected to reach about 36,000 tons a year by the end of 1941. Latest expansion plans announced involve operations at the Freeport, Texas, plant of The Dow Chemical Company. Capacity at that new project will be increased to 9,000 tons a year. Total domestic production in 1940 was 6,250 tons. There is talk in Washington of a possible downward revision in the price of metallic magnesium within the next few months. The current quotation is 27c. a pound for ingots, carload lots.

CALIFORNIA

Large Tungsten Mill Being Constructed

Plant under erection near Bishop will have capacity of 1,000 tons of tungsten ore per day—Milling operations at Church mine expected to start in June

▶ What will be one of the largest tungsten mills in the United States is now under construction on the Pine Creek property on Morgan Creek near Bishop by the United States Vanadium Corporation, the operators. The new plant is designed to handle 1,000 tons of ore a day, and will be connected with the mine by a two-mile aerial tramway using 1¼-ton buckets to be erected soon. The company is a subsidiary of Union Carbide & Carbon Company, and also operates a large number of vanadium mines in Southwestern Colorado. Blair Burwell is general superintendent for the California and Colorado properties, with M. N. Shaw, superintendent, directing operations at the Pine Creek unit. About 275 men are currently employed.

▶ According to word received from W. J. Loring, managing engineer in charge of operations of the Madre de Oro Gold Mines, Inc., in El Dorado County, erection of surface plant units and a mill is proceeding satisfactorily, and milling operations are expected to start in June. The company operates the Church gold mine adjoining the Union mine near Placerville, El Dorado County, which is developed by a 1,200-ft. vertical, three-compartment shaft affording access to nine levels. The property was reopened by the present operators a short time ago after many years of idleness. Construction of the mill containing 20 stamps, two ball mills with classifiers and jigs, and 16 flotation cells, all arranged in two sections to form two distinct operating units, is more than 70 percent completed. Ore will be sent to a large jaw crusher and transported to the mill by a belt conveyor 400 ft. long. At the mine an 80-ft. steel headframe and a 200-ton steel ore bin have been completed. The mill will have a maximum capacity of 350 tons, with the two-unit design offering all elements of flexibility as to control and tonnage treated. Executives of the company are Forest Riley, president, Hazel Riley Mitchell, secretary-treasurer, and B. H. Winslow, vice president.

▶ Lava Cap Gold Mining Corporation, Otto E. Schiffner, vice president and general manager, operating the Banner and Central mines near Nevada City, Nevada County, has declared a dividend of 2 cents per share paid March 31. The company recently completed and placed in operation a new cyanide plant at the Central shaft, and a comprehensive diamond drill campaign is in progress in the Banner mine. Daily production averages 400 tons and about 330 men are employed.

▶ The shaft at the Boundary mine at Grass Valley, Nevada County, has reached a depth of 720 ft., with sinking still in progress. Two electric pumps were installed recently to handle the increased flow of water encountered a short time ago. The property is operated by John N. Becker, Grass Valley mining engineer, with Phil Dowd, superintendent, in charge.

▶ About 12 men are reported to be employed at the Red Rock quicksilver mine in the Cachuma district of Santa Barbara County, now operated by the Red Canyon Mining Company, Hugh Wright, president. The property is about 12 miles east of Los Olivos.

▶ A new 250-ton ball mill and additional milling machinery, including flotation cells, are in course of installation at the Empire mill of Empire Star Mines Company, Ltd., Grass Valley, Nevada County. The 80 stamps now used for providing the feed for the concentrating tables and cyanide plant will be retained to serve as a primary crushing unit. Mill capacity will be materially increased by the addition of these units. J. R. C. Mann is general manager.

▶ Atolia Mining Company operating at Atolia, Kern County, has completed alterations at its treatment plant producing tungsten concentrates, and plans early reopening of the Amity and Union No. 1 mines. A new tailings pond is under construction to accommodate retreated and new tailings. Hugh W. Coke, superintendent, is in charge of operations.

It Happened in Sixty-Six

Engineering and Mining Journal was established 75 years ago this month as the American Journal of Mining. Our anniversary will not be celebrated, however, until next August, when we shall publish a Diamond Jubilee issue of E.&M.J. In the meantime, we shall reprint each month a few selected items from Journals of 75 years ago. The following are culled from the issues for April 1866.

Salutatory

Buoyed by the kind assurances of many influential friends—some of them well known in their several departments of science—I assume editorial control of the JOURNAL OF MINING with a determination, so far as lies within my capacity, to make it a success. Puffery is my special abhorrence, and so long as I conduct the Journal nothing of the kind shall be seen in its editorial columns. Politics—in the popular acceptation of that term—will be utterly ignored, because incompatible with the spirit and scope of such a paper. Without any further promises, I prefer to let the Journal stand upon its own merits. GEORGE FRANCIS DAWSON.

Central Pacific Railroad

It is reported on good authority, that the Central Pacific Railroad—in course of construction from Sacramento City, California, to Salt Lake City—is rapidly progressing. Fifty miles have been completed and the working force will be largely increased this spring.

Compressed Air

Compressed air, as a motor and medium for ventilating mines, has now been brought into practical and successful operation, and the day cannot be far distant when it will be in general use. Compressors are manufactured in this city (New York), with which a pressure up to 220 pounds is readily attained.

Copper Memorial

The Detroit Board of Trade have adopted a memorial to Congress, asking an increase of duty on copper, so as to protect the copper interest of Michigan.

New Overland Mail

From the 16th inst., the Holliday Mail and Express Company will run a daily mail from Topeka, Kansas, the present terminus of the Pacific Railroad, to Denver, by way of the Smoky Hill route. The overland mail, by the Platte route, has been so overloaded with letters, that it has for two years been impossible to get a transient newspaper through unless by the payment of full letter postage.

School of Mines

We have all felt the need of a School of Mines. Such an institution has long existed in Saxony, and has produced many very eminent practical men, who have made mining in Europe a safe, legitimate and profitable business. To meet this want there has recently been established, in New York, the School of Mines of Columbia College. Here may now be educated, under the direction and guidance of eminent scientific men, hundred of our young men annually, at very trifling expense.

Admission of Colorado

It is now stated, that there is no hope for the admission of Colorado during the present session of Congress. While we are deeply solicitous to see the mining States and Territories duly represented in the National councils, we must gracefully submit to the decision of the powers that be. We indulge the hope that at no distant day, Colorado will again apply for admission, with more unanimity among her citizens, and with better success.

ARIZONA

Copper Miners Receive Daily Wage Increase

More than 10,000 workers given pay boost in recognition of present national situation—Shaking conveyors installed at Ray unit of Kennecott Copper Corporation

▶On March 24 Arizona copper miners and smelter workers were granted a wage increase of 25c. per day. The notice first posted by Phelps Dodge Corp., and signed by H. M. Lavender, general manager, read as follows: "These increases effective March 23 have been granted in recognition of the present national situation, and will, therefore, remain operative only so long as this situation continues to exist."

▶Production at the Ray property of Kennecott Copper Corp. was gradually increased and copper output in 1940 was the largest since 1928. Expenditures for improvements were small. Several shaker conveyors were installed underground. The crushing plant dust collecting system was further improved and in the concentrator the grinding rolls in Sections 3 and 4 were replaced by a rod mill.

▶Some new veins are reported discovered in the Sunnyside mine, south of Oatman, in Mohave County, by J. C. Cook and Jack Brock, who leased the property last year. One stringer 6 in. wide is said to assay several ounces in gold per ton. This section of the Oatman district has generally been considered as containing very low-grade ore and the present disclosure has attracted attention to that district.

▶Development of the Pipe Line and Santa Rita placers, in the Greaterville district, has started under the direction of E. E. Maillot, of Salt Lake City, Utah. The property is owned by Louis G. Hummel, of Tucson, and the Pipe Line placer by the Richardson Corp., of Patagonia, Ariz.

▶Kingman Feldspar Co., at Louise, two miles east of Kingman, has installed a new dust collector in its crushing and screening plant. The Kingman Feldspar Corp. is a subsidiary of the Consolidated Feldspar Corp., H. P. Margarum, president, 1403 Trenton Trust Building, Trenton, N. J. Harry W. McIntyre, of Kingman, is local manager.

▶Manganese ores from the War Eagle mines, situated 25 miles northwest of Bouse, Ariz., and owned by S. J. Curtis, have been shipped to the U. S. Bureau of Mines laboratory at Salt Lake City, Utah, for analysis. It is understood that a diamond drilling program is being planned to determine the extent of the deposit.

▶The Cochise Mining Co. has purchased a Linco gold-washing plant and will use it on its placer properties in the Tevis-ton district of the Dos Cabezas Mountains near Willcox. L. L. Ledford, of San Simon, Ariz., is president.

▶O. H. Wall and associates have begun operations on the Apache mine, in the

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View of the 1,000-ton concentrator of the Magma Copper Co. at Superior, Ariz. In 1940 this plant treated 237,003 tons of copper ore, assaying 5.16 percent copper, and 78,044 tons of zinc-copper ore, assaying 1.74 percent copper and 7.31 percent zinc. The over-all tailings averaged 0.29 percent copper, and over-all copper recovery was 85.61 percent

▶ARIZONA

Mineral Mountain district 9 miles southwest of Superior. The property was formerly known as the Coronado mine and the principal value is in gold with a little copper.

▶W. D. Thornton, president of Inspiration Copper Co., Inspiration, Ariz., in his annual report to stockholders said 3,423,755 dry tons of ore assaying 1.264 percent total copper were mined in 1940. The average tonnage of ore mined per working day was 11,116, produced at the rate of 33.93 tons per man-shift. The area undercut and caved during the year was 4.944 acres. The mine is in excellent condition, with development work and reserves of broken ore well in advance of current requirements. In the main leaching plant there were treated, by ferric sulphate leaching, 3,187,037 dry tons of ore from which the slimes had been removed. This ore averaged 1.250 percent total copper. Extraction was 98.464 percent of the oxide, and 77.629 percent of the sulphide, or 88.480 percent of the total copper. Power consumed in the electrolytic precipitation of copper from main leaching plant solutions was 1.391 kw.-hr. (a.c.) per pound of copper deposited. The slimes removed from the ore were treated at the concentrator for the recovery of their sulphide copper content by flotation, and the tailings from this operation were treated with sulphuric acid solution to dissolve the oxide copper. The combined recovery from concentration and leaching of slimes was 81.706 percent of the copper, and the total metallurgical recovery of copper from the entire operation of ore and slimes treatment was 87.896 percent. The copper in the slimes-leaching solutions was precipitated on scrap iron, and the resulting cement copper, with cement copper from the stripping of excess wash water from the main leaching plant, together with the concentrates from the slimes, was smelted at the International Smelting & Refining Co.'s plant at Miami, Ariz. The copper production for the year was 76,119,435 lb. Total power requirements of the company's operations during the year amounted to 120,328,243 kw.-hr. The company's steam power plant's output was 93,969,200 kw.-hr., the balance used being hydro-electric power supplied by the Salt River Valley Water Users Association. The water development 11 miles north of the Kiser pumping plant was completed and pumping operations began March 15, 1940, and since that date this development has supplied practically all the plant water requirements. Thomas H. O'Brian is vice president and general manager and F. A. Wardlaw, Jr., is assistant general manager.

▶Leeds and Kimball, holding an option on the Mohawk group of claims northwest of Superior, are improving the road to the mine to haul in mining equipment for development of the property.

▶Manganese ore is being shipped from the Big Four mine, 13 miles east of Gila Bend, Ariz. The ore is reported to run about 40 percent manganese and is obtained from open cuts. It is planned to increase the production by the addition of a larger force of miners. The property is owned by J. D. Lynch and H. B. Gannaway, of Glendale, Ariz.

▶East Vulture Mining Co. is erecting a 500-ton sand-leaching plant at the old Vulture mine. The new mill will supplement the cyanide plant, now handling about 225 tons a day. The ore is mostly from surface workings. Ernest R. Dickie, of Wickenburg, Ariz., is president and general manager.

▶Thomas Bardon, president of the Shattuck Denn Mining Corp., in a report to stockholders, stated that in 1940 there were produced at the Denn mine, at Bisbee, 13,264,256 lb. copper, 808,685 lb. lead, 3,082,675 lb. zinc, 9,446 oz. of gold, and 318,158 oz. of silver. Development is being continued on a small scale at the Shattuck mine. Additional shares of stock of the 79 Lead-Copper Co. were purchased and the company now owns approximately 57 percent of the outstanding stock of 79 Lead-Copper Co. With the proceeds of such sales the 79 Lead-Copper Co. is carrying on exploratory work at its property. To date the results of such exploration have been inconclusive.

Public Health Service Offers Hygiene Program for Mines

A COMPREHENSIVE BULLETIN outlining spectacular strides in development of industrial hygiene programs throughout the country under the leadership of the Industrial Hygiene Division of U. S. Public Health Service is now available to mining operators interested in improving the health of their workers as a means of increasing production and cutting "lost-time" costs. (Public Health Service Bull. 259. For sale by the Superintendent of Documents, Washington, D. C. for 20c).

The division works primarily through state industrial hygiene agencies, but its staff and services are also available to industry where needed to augment local organizations or where these do not exist. Industrial hygiene is a comparatively recent addition to public health work; as late as 1935 only five states had such services. Now, 32 states have some kind of organization, and state industrial hygiene budgets have passed the half-million dollar a year mark.

Straight-line casting wheel for blister copper at the smelter of the Magma Copper Co., Superior, Ariz. Copper output from this plant in 1940 totaled 34,847,474 lb.

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NEWS FROM Washington

By Special Correspondent

CONTROL by Washington tightens steadily on most lines of business. Because metals and other mineral products are so vital to a large part of defense preparation, these commodities are among the first to feel the official restraints and rulings. By the end of March Washington had gone so far as to initiate actual price fixing. Aluminum scrap furnished the test case for this procedure.

It is expected that the present trend of intimate control by government ruling will continue until it encompasses practically all metal movements and prices. No matter how effectively most divisions of these industries may function, there is prospectively shortage or difficulty in supply at certain times or places. The official philosophy is that "Washington knows best." And official Washington is not hesitant in expressing its opinion in the form of enforceable orders.

Collar-to-Collar

CONTRARY to the expectation of the mining industry, Wage-Hour Administrator Fleming confirmed on March 31 his tentative finding on hours of work in metal mines. He ruled that the work day should be figured on a collar-to-collar or portal-to-portal basis, and denied the operators' request for reconsideration of his earlier opinion. This arbitrary rule caused surprise and consternation because the Administrator had previously announced a policy of not interfering with long-established custom, or changing practice under existing bargaining contracts. Just what caused the abrupt shift in policy was not announced, but it was clear that a fundamental and new issue was established by the ruling. Certainly it goes contrary to the preponderance of the evidence submitted at field conferences in Salt Lake City and Birmingham. Unless appeal is carried to the courts, the collar-to-collar ruling will stand, with the effective date postponed from April 1 to May 1. (See page 88.)

Defense Plant Money

WASHINGTON continues to talk about encouraging more private investment in defense projects. But all official actions are of the opposite effect. By the end of March there was practically no further expectation that new plants definitely requested by Uncle Sam would secure private financing if they were willing to take government money. The Defense Plant Corp. thus became more than ever almost "exclusive banker" for new OPM business expansion.

The magnesium industry perhaps brought this situation to a head most strikingly for the metal and mineral industry group. The production division of OPM became very nervous about the slow progress being made on new magnesium contracts. It had talked with six or eight important companies; but none of these was really ready to sign on the dotted line. Their hesitancy appears to have been almost invariably because they need more technical information from current experimental work on an engineering scale. Some of them frankly told officials that they did not quite yet know just what sort of plant they wanted to build, nor where.

Fearing further delay, officials urged that Dow Chemical Co. double the capacity of its Freeport, Texas, plant. That was arranged under a contract by which Defense Plant Corp. furnishes the money. Dow becomes designer, builder, and operator, with the title of the new property remaining with the R.F.C. subsidiary. All previous construction of magnesium plants had been on the bases of private ownership.

It is expected that the capital risk taken by new contractors in the future will be largely eliminated through this Defense Plant Corp. method. The contracts used will provide for leasing of the new facilities to the private company, with the privilege of purchase at the end of the contract period.

Price-Fixing Rules

OTHER DIVISIONS of industry having no concern with aluminum, either primary or secondary, will find the pattern to be followed for other metals in the orders issued by Defense Commissioner Henderson on March 24 in the case of aluminum scrap and secondary ingot. The price schedules announced on that date and the interpretation by Mr. Henderson's office are very illuminating.

The maximum price is named f.o.b. point of shipment, classified according to the type of scrap and according to the character of the seller, whether he is the one who made the scrap or is a dealer. The prices for secondary ingot distinguish between various grades over a range of a cent a pound in the maximum price permissible; but they are applicable only to producers of the ingot.

That comparable schedules are to be expected in many metals was made clearly evident in the following official statement: "Schedules are imminent in iron and steel scrap as well as zinc scrap, and apparently unwarranted price increases in various other industries have been reported during the past few days. Should these movements continue, price ceilings will have to be established in these industries."

Nickel Restrictions

RESTRICTION on nickel so that the limited supply would go for most essential uses was found necessary by OPM on the basis of a report to it by the National Academy of Sciences special advisory committee. That report was officially summarized as follows:

"Nickel is being currently supplied to the United States market at a rate more than double that of any year prior to 1939, at a monthly rate of about 14,500,000 lb., compared to 6,900,000 lb. in 1937.

"Nevertheless, in consequence of mounting United States and British defence requirements as well as of sharply increased industrial requirements during recent weeks, even this enhanced supply is temporarily, at least, inadequate to meet the current even larger demands of nickel users.

"Unless the volume of defence requirements should later definitely be established to be greater than the figure now known or estimated, it is too early to regard the present extraordinary demand as other than temporary."

Quicksilver, "At a Price"

"THE price of quicksilver is too high and a lower level can and should be reached." This is the official finding of Leon Henderson, Industrial-price Commissioner, promulgated March 28. Apparently the announcement was intended to imply that the present excess of production over domestic requirements would justify forcing the price down to the point that would just balance output against needs. Official comment did not state this categorically; but apparently this idea was intended to be clear between the lines.

Domestic output is at the rate of 40,000 flasks a year. "This," it was stated, "exceeds the indicated total consumption including requirements for national defense." And, "Speculation or inventory hoarding, based upon the expectation of increased defense requirements, is clearly unwarranted. Present prices are already resulting in a trend to substitution of other materials for mercury, and although the spot market presents an artificial appearance of tightness, large users are receiving offers to supply their substantial requirements over a protracted period at materially below the spot price. . . ."

Metal Advice Sought

THE newly enlarged advisory committee on metals has been asked a series of pointed questions about six strategics. Five of these are metals on which economy in use is sought; the sixth (beryllium) apparently comes in for a bit of promotion. The questions are officially summarized by OPM as follows:

"Tin—The possibilities of substitutions and conservation of tin, and of conservation in the can, collapsible tube, babbitt, and solder industries. The possibilities of conservation in bronzes are also to be studied.

"Tungsten—The possibility of substituting molybdenum or other metals for tungsten, and the conservation of tungsten use.

"Zinc—Possibility of savings in zinc consumption, including general reduction in the use of zinc in galvanizing steel sheets and possible changes in the

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formula of various types of brass in the direction of higher copper and lower zinc content.

"Graphite—Possible substitutions for graphite crucibles and retorts for nonferrous work, graphite crucibles for iron and steel, and graphite stoppers for steel ladles. These all use flake graphite, which is becoming difficult to obtain. The Office of Production Management asked especially concerning substitutions, such as iron and clay-lined iron pots, and clay stoppers.

"Lead—In view of the shortage of magnesium there will be decreased production of high-grade corroding lead, because magnesium is needed for debismuthizing. What are the possibilities of using leads of higher bismuth content than now demanded in the various industries, or of correcting this situation by other means?

"Beryllium—Possible use of beryllium in the defense program."

News "Fines"

Metal Saving—OPM has established a unit which will direct the conservation, reclaiming, and substitution of strategic metals and minerals essential for defense. It is headed by Robert E. McConnell, an experienced mining engineer and business man acquainted with this type of industrial activity. The purpose will be to establish and keep open channels for prompt flow of reclaimed strategic metals back into the consumption industries. Substitution of new materials for those difficult to secure in adequate quantity will be encouraged through this office also.

Zinc Probe Starts—The Anti-trust Division of the Department of Justice during mid-March began an investigation to determine whether increases in the price of zinc had been due entirely to "natural market conditions." Subpoenas called on important industry men to bring records and pertinent material before the investigators, who believe some have indulged in agreements violating the Sherman Act and other anti-trust laws.

Two Billions a Month—By mid-year the actual disbursements from the Federal Treasury are expected to reach approximately two billion dollars per month. This rate of spending includes defense, aid to Britain, and "normal" government activity, whatever that may mean. The calendar year 1942 may require disbursement well over thirty billion dollars if present rates of acceleration are continued as hoped for. No one longer talks about budgets, balanced or otherwise.

Engineers or Miners—The controversy about mine inspection now centers on the kind of inspectors who are to be named. The House of Representatives thinks that men should have had some training in mining engineering before they are put in charge of formal inspections by the Federal Government in coal mines. The Senate was willing to have those "experienced in coal mining" chosen. This would, according to critics, enable Secretary Ickes to name union organizers who would merely have to demonstrate that they had worked underground for five years in order to qualify. The issue is of great importance because the type of inspector used will probably determine the resulting technic, irrespective of the nominal attitude of the director of the Bureau of Mines, or perhaps even somewhat independent of the Secretary of Interior's views. As April opened there seemed to be no question that the full compulsory Federal mine inspection system would be under way by July 1.

Strikes Stopped—No one about Washington doubts that OPM Administrator Knudsen accurately reflected both public and official thinking when he, assisted by Secretary Knox, ordered Allis-Chalmers to resume plant operations. All but the extremest leaders of labor admit that this action did much to stop certain strikes. And it also stopped Congress, at least temporarily, from legislating in a fashion that would be most radically anti-union of anything that has happened in 20 years. More labor trouble is expected; but Congress is for the time sufficiently satisfied that the legislation which was expected during March may not materialize at all. Friends of labor hope that certain union groups will not fail to take the hint and do a bit of house-cleaning to get rid of radicals of dubious political faiths.

Machinery Priorities—The priority rules promulgated on March 19 by OPM list a very large number of commodities and varieties of equipment. They also establish regulations by which priority for new machinery can be extended to those preparing materials essential for defense. Ultimately, mine, smelter, and other mineral-working industries will have to resort to these rules in order to get machinery, and perhaps even for replacement and repair parts.

Arkansas Manganese—Continuing the domestic manganese policy established last year, Metals Reserve Co. has contracted for 100,000 tons of Grade A manganese ore to be delivered during the next three years by Manganese Cooperative Producers Association. No government money for construction is involved. The contracting association hopes to borrow the funds to build and operate a manganese recovery unit at Helena, Ark., using the Bradley-Fitch process. That process employs ammonium sulphate for the extraction of manganese from moderate-grade ores. Engineering plans for the project are well under way, but actual construction had not started at the first of April, Washington understands.

Smelter Smoke Findings—On March 12 the Trail Smelter Arbitral Tribunal presented its final decision with reference to damage in the State of Washington by fumes from the smelter at Trail, B. C. The formal international conclusion is that there has been no further smoke damage in this area since Oct. 1, 1937, the last date for which a report for award of damages was rendered. The Tribunal does conclude, however, that a continuance of precautions to prevent escape of sulphur fumes is essential in order to prevent recurrence of damage experienced some years ago.

Collar-to-Collar Vs. Face-to-Face

Wage-Hour Administrator defends interpretation of "hours worked" in underground metal mines

Col. Philip B. Fleming,

Administrator, Wage and Hour Division, Department of Labor

THE EDITOR of *Engineering and Mining Journal* has asked me to reconcile, if I can, the statements I made in my speech before the American Mining Congress on Sept. 18, 1940, with my recent approval of an examiner's report announcing our opinion that in effect hours worked in underground metal mining include all hours spent portal to portal minus the lunch period. The portal-to-portal opinion is summarized as follows:

"The workday in underground metal mining starts when the miner reports for duty as required at or near the collar of the mine, and ends when he reaches the collar at the end of the shift.

"The workday also includes the aggregate of the time spent on the surface in obtaining and returning lamps, carbide and tools, and in checking in and out.

"The workday does not include any fixed lunch period of one-half hour or more during which the miner is relieved of all duties, even though the lunch period is spent underground."

I cannot fully reconcile the two but I can at least explain how my name is attached to the irreconcilable. One of the first public statements I made on any matter affecting the metal-mining industry was issued in the form of a press release on July 27, 1940, with the title, "Two Mining Determinations Announced." One of these administrative determinations dealt with the subject of lessees, a subject which we are still investigating and on which further announcements may be expected in the future. The other so-called administrative determination was made in answer to an inquiry from the bituminous coal mining industry. Since this is the ancestor of all subsequent confusion it is worth quoting in full. Our press release states: "On the basis of an inquiry submitted by the bituminous coal mining industry, the Wage and Hour Division in carrying out its enforcement duties in that industry will accord great weight to any reasonable standards for determining working time which represent the prevailing customs and practices in the particular industry and are supported by a long history of *bona fide* collective bargaining agreements. In view of the circumstances described by the industry in submitting its inquiry, I announced that practice of computing working time on a 'face-to-face' basis in the bituminous coal mining industry would not be unreasonable. . . . I added that the determination in the bituminous coal mining industry should not be considered to apply to any mining operations where the traditional practice of computing hours worked differs from the custom in the bituminous coal mining industry." When I made my speech in Colorado Springs six weeks later I quoted that statement and I

added to it the following sentence: "In the Cornucopia case, for example, custom and tradition had long recognized the portal-to-portal basis of reckoning time worked." It is the implication of that last statement which has led many mining operators to believe that the Wage and Hour Division would accept the face-to-face practice or some modification of face-to-face or portal-to-portal in any mine where the practice had been carried on for a long time. Because of that assumption many mine operators were surprised at my affirmance of the examiner's report on hours worked in underground metal mining in which I accepted for the Division the position that hours worked in metal mines should be counted as portal-to-portal minus the lunch period.

I am afraid that I must take the blame for making a misleading statement.

The decision we made last July to accept the face-to-face computation of hours worked in bituminous coal mining was reached with considerable difficulty. However, right or wrong, my bituminous coal opinion was based on a unique situation. Here is a large industry with about half a million employees in which the method of computing hours worked is virtually uniform throughout the industry and has been for many years. Furthermore, it is an industry in which this uniformity in agreement on hours worked has been achieved by national collective bargaining, and arrived at by the employers and the employees year after year in joint meetings which go back for half a century. So far as my knowledge goes the determination of working hours has not been established in this way and with such uniformity in any other industry in the United States.

In underground metal mining the practice with regard to hours worked is entirely different. Only part of the industry operates under collective bargaining agreements, and the agreements are characteristically made on an individual mine basis. Different contracts contain different hours provisions. This diversity in practice under union contract is reflected in a diversity of practice in unorganized mines. In practically every state of the Union except the states of Utah and Arizona, where the collar-to-collar system is required by law, and possibly the states of Alabama and Tennessee, the practice in the immediate past has reflected all the different bases for computing hours worked. In a general way I was familiar with this condition when I made my address at Colorado Springs. I suppose that in citing the Cornucopia case, which involved a consent decree agreed to by a mining company for its mine in the State of Oregon, I merely felt that I was giving a single practical example of the type of thing I had in mind. Actually, as many mining operators have since reminded me, I gave the impression that the Wage and Hour Division would accept the *status quo* in each individual mine in the United States as of Oct. 24, 1938, the day the act went into effect, as determinative of hours worked in that particular mine under the Fair Labor Standards Act. Since the date of the speech, we have learned far more about the metal mining industry than we then knew. We have received reports from our regional offices, made surveys, held public conferences. We know now, and we probably should have realized then, that acceptance by the Division of the individual custom of each individual mine would tend to continue a chaotic condition. It would make permanent a lack of standards instead of establishing the standard contemplated in the law. So, to repeat, if I had realized on Sept. 18, 1940, what I know today, I would not have made the kind of loose statement that appears in the speech.

The general opinion of the Wage and Hour Division on determination of hours for which employees are entitled to compensation (straight time and overtime) under the Fair Labor Standards Act was originally explained in the Division's Interpretative Bulletin No. 13. This was first issued in May, 1939, and while it has been revised at various times the basic principles that our attorneys drafted then are still the basic principles to which we adhere. The bulletin says: "As a general rule, hours worked will include (1) all time during which an employee is required to be on duty or to be on the employer's premises or to be at a prescribed workplace, and (2) all time during which an employee is suffered or permitted to work whether or not he is required to do so. In the large majority of cases, the determination of an employee's working hours will be easily calculable under this formula and will include, in the ordinary case, all hours from the beginning of the workday to the end with the exception of periods when the employee is relieved of all duties for the purpose of eating meals.[1]"

I believe that a fair reading of that paragraph would lead most persons to conclude that the portal-to-portal method of computing hours worked in underground metal mining is the correct one. In the examiner's report the position is taken, and I think correctly, that any meal period of half an hour or more even though underground is not hours worked. On that one point, we have finally expressed an opinion where no opinion was expressed before. As for the rest, I believe that the report which I have adopted is an application to the underground metal mining industry of the principles which we made known earlier in the administration of the act. But even that general statement in the bulletin, sound though it is, has been the source of some confusion. The word "workplace" is used in the bulletin to indicate any place to which an employee may be sent away from his employer's regular place of business; in metal mining it is customarily used to indicate the spot within a mine to which the miner is assigned. This was clearly not the sense used in the bulletin, but the bulletin has occasionally been thus misconstrued.

This is the history of the Wage and Hour Division position on the collar-to-collar question. What will the Division do about it? First, when the collar-to-collar opinion was approved on March 17, 1941, we stated that for administrative purposes we would consider its effective date to be April 1. Since that time we have realized that it would be fairer to allow a little more leeway to employers to adjust their practices. We have therefore postponed the effective date from the administrative standpoint to May 1, 1941. Second, we have announced that if any employer complies with the wage and hour provisions we will take no action with regard to noncompliance prior to May 1, 1941. Thus any employer whose compliance begins by May 1, 1941, will know that the Wage and Hour Division will not concern itself with the previous method of computing hours worked for his underground employees.

[1] "No opinion can be expressed at this time as to certain cases—e. g., employees engaged in mining or in working under high pressure —where by custom or agreement time spent eating meals is paid for as hours worked."

American Zinc Institute to Meet

THE annual meeting of the American Zinc Institute will be held in St. Louis on April 28 and 29. Zinc and its place in national defense will be stressed on the program.

The Galvanizers Committee, which is sponsored by the American Zinc Institute, will hold its spring meeting May 1 and 2 at the William Penn Hotel, Pittsburgh. The program provides for a full day of plant inspections, including a visit to the Vandergrift plant of the Carnegie-Illinois Steel Corp. Problems in galvanizing under present unusual conditions will be discussed, particularly in reference to the demand and supply situation in zinc.

Write Off for Plant Expansion

Certificates of necessity permitting plant expansion to be written off in 60 months on tax returns as of the end of February have been granted as follows:

Company	Product	Sum Involved
African Metals Corp.	Cobalt metal and oxide	$570,000
Allegheny Ludlum Steel Corp.	Steel and alloys	1,045,000
Aluminum Co. of America	Aluminum, electrodes, etc.	33,523,000
Aluminum Ore Co.	Alumina, etc.	5,086,000
American Smelting & Refining Co.	Zinc	308,000
American Zinc Co. of Illinois	Zinc	1,185,000
The Dow Chemical Co.	Magnesium	12,249,000
The Dow Chemical Co.	Magnesium, castings	1,105,000
New Jersey Zinc Co.	Zinc	1,258,000
New Jersey Zinc Co.	Zinc oxide	101,000
Electro Metallurgical Co.	Ferro alloys	10,827,000
Carolina Aluminum Co.	Aluminum and electrodes	1,381,000
Reynolds Metals Co.	Aluminum	7,453,000
Western Cartridge Co. (Ill.)	Brass	4,173,000
Potash Co. of America	Potash	427,000
Pittsburgh Metallurgical Co.	Ferro alloys	111,000
Republic Mining & M'f'g Co.	Bauxite	503,000
United States Vanadium Corp.	Tungsten ore	1,613,000

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CLEVELAND OHIO

View of zinc concentrator operated by Peru Milling Co., near Deming, New Mexico. This company recently acquired the zinc properties of the United States Copper Company at Hanover, New Mexico

NEW MEXICO

Improvements Made at Chino Copper Mine

Kennecott Copper Corporation reports that several installations of new equipment during 1940 are contributing to operating economies

▶ The Chino property, a unit of the Nevada Consolidated Copper Corp., of Kennecott Copper Co., showed a large increase in production in 1940, the copper output exceeding that of any prior year. Capital expenditures, which were comparatively large, were devoted to installations to effect reductions in cost. At the mine the shovel pit was equipped for electric haulage and partly double-tracked, with operating results fully justifying the expenditures. Thirteen 30-yd. dump cars and a 5-yd. electric shovel were added to mine equipment, and the shops serving the mine were moved to the pit entrance and greatly improved. A larger high-tension transmission line was installed between the power plant at Hurley and the mine. At the power plant the installation of a high-pressure boiler and of a turbo generator was completed and the modernized plant is now operating with marked economies. For further accommodation and welfare of employees, 25 additional dwellings were constructed at the mine at Santa Rita and 40 at the mill and smelter townsite at Hurley.

▶ The purchase of the United States Copper Co. properties at Hanover by the Peru Mining Co. was announced in Silver City recently by Joseph H. Taylor, manager and vice president of the Peru Mining Co. Production and development are under way and plans have been made to increase zinc output. The company is the largest zinc producer in the district and both its mine at Hanover and mill at Deming have been operating at capacity.

▶ During 1940, the American Metal Co., of New Mexico, which is in the process of liquidation, disposed of its inventories of zinc and paid its current debt of approximately $700,000 to the American Metal Co. In addition, $75,000 was received from this controlled company against its debt relating to bond interest in arrears. Since the New Mexico company's mining operations have been discontinued and its current assets at Dec. 31, 1940, are insignificant, its financial statements were omitted from the annual report of the American Metal Co.

Keep Blasting Caps From Children

WARNINGS are being broadcast by the Institute of Makers of Explosives asking all users of blasting caps to make sure that they do not fall into the hands of children. The campaign to prevent accidents of this type has been carried on continuously since 1926 by the manufacturers who comprise the Institute. Last year there was a reduction in the number of children injured—157, compared with 195 in 1939.

Statistics collected by the Institute show that children explode the caps by picking them with nails or pins, hammering them, or throwing them into fires. It will be a public service if all users of explosives will make certain that blasting caps are not left where they will fall into the hands of children.

NEVADA

Activity to Increase on Quicksilver Properties

Cordero Mining Co. will exploit cinnabar deposits in Humbolt County and three mercury producers in Pershing County optioned by Bradley Mining Co.

▶ Reputed to be a subsidiary of the Horse Heaven Mines, Inc., which operates a mercury furnace near Ashwood, Ore., the Cordero Mining Co. has been incorporated in Nevada and has acquired cinnabar claims in northern Humboldt County on which employes of the Horse Heaven company have been conducting prospect work for several months. J. Edgar Pew, of Philadelphia, head of the Sun Oil Co., is president of the Horse Heaven and Cordero companies. The mine office is at McDermott, Nev.

▶Three contiguous cinnabar properties in the Goldbanks district, eastern Pershing County, which have supplied ore for small retort furnaces at intervals for a number of years, were reported taken under option by the Bradley Mining Co., of San Francisco, of which Worthen Bradley is president, and John D. Bradley, vice president, with offices in the Crocker Building, San Francisco. O. L. Cash, of McDermitt, via Winnemucca, is directing preliminary work.

▶A large tract known as the Mattinson placers, situated in the Leonard Creek district in northwestern Humboldt County, has been acquired under option by the Goldfield Consolidated Mines Co., and test work is in progress. Two other placer properties in the same district are being worked with small washing plants that are to be enlarged. All options and activities outside of Nevada have been abandoned excepting for the company's interest, 17,238 shares, in the Livengood placers in Alaska.

▶It is reported that a larger rotary furnace will be provided for property of the Governor Mercury Co., in the Ivanhoe district, 16 miles southeast of Midas, in western Elko County. The Federal RFC was said to have approved a Class B loan of $20,000 to the company, which is headed by James M. Curley, of Boston, former Governor of Massachusetts.

▶The Freeport Sulphur Co., with a western office and engineering staff at Reno, has taken an option on the old Majuba Hill copper mine, in the Antelope district in Pershing County, and has started prospect work to check the geology in connection with an isolated shoot of tin ore, said in reports to be composed of cassiterite, tourmaline, and quartz. A. A. Gustafson, with offices in the Gazette Building, Reno, is engineer in charge of operations. David LeCount Evans, formerly with Climax Molybdenum, is staff geologist, and the Majuba Hill work is directed by R. S. Munsell, lately with the E. L. Cord interests at Silver Peak.

▶Capacity of a tungsten mill operated by the Nevada Scheelite, Inc., 9 miles southeast of Rawhide, in Mineral County, has been increased from 30 tons to 100 tons per day by addition of a new crusher and ten concentrating tables. New trucks have been provided to convey the ore about three miles from mine to mill. Ore is being mined from the 200-ft. level of the incline shaft. A. J. Mills is in charge at Rawhide.

▶Getchell Mine, Inc., in Nevada, in which Nemont Mining Corp. continues to hold an 18.6 percent interest, milled 339,915 tons in 1940 with a net recovery of $6.53 per ton. Dividends of 39c. per share were paid during the year on its issued capital of 1,500,000 shares.

▶At the Nevada division of Kennecott Copper Corp. the stripping program on the south and southwest sides of Liberty Pit was finished down to and including the fifth level, in 1940, thereby completing the extensive stripping operation inaugurated some three years ago. As a result, current stripping expenditures are reduced 50 per cent. Improvements and additions to equipment included the

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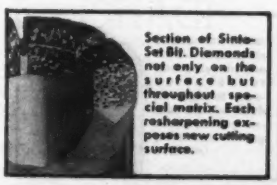

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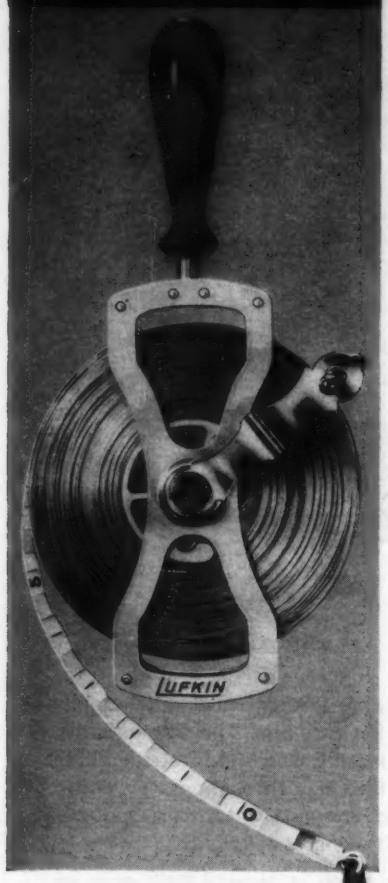

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TAPES RULES PRECISION TOOLS

The recently completed plant of the Cinnabar Mountain Mining Co. to recover quicksilver from the Reward mine is located near Mina, Nev.

▶NEVADA

reconstruction of the 20-mile transmission line from the power plant at McGill to the mines at Ruth, and the installation of a 15,000-cu.ft. blower for flotation air at the mill and of a boiler at the power plant.

▶Cinnabar Mountain Mining Co., under the general managership of Dallas H. Gray, Jr., is operating the Reward mercury mine, east of Mina, under lease and bond. Construction of the new reduction plant was begun in November, 1940, and completed in February, 1941. It comprises a 3x50 ft. rotary furnace fired by butane, and condensing equipment. Capacity is 30 to 50 tons. R. J. Canavan, of Tonopah, is superintendent. Ten men are employed.

▶On Oct. 4, 1940, the West Coast Mines, Inc., awarded a contract to the Western Knapp Engineering Co. for the construction of a 150-ton flotation plant, complete with crushing and milling unit, together with a 7½ mile 60,000-v. power line, a 20,000-ft. water line with deep well and booster pump, water storage tank, and several other surface buildings, including an assay office, change room, shop room, and office building. The mill is located near Winnemucca, Nev., and the plant was ready for operation in February, ahead of schedule.

IDAHO

Sunshine Consolidated Strikes High-Grade Ore

Crosscut from its Jewell shaft reveals wide vein carrying silver — Bureau of Mines discovers tungsten deposit

▶Sunshine Consolidated was the scene of an important ore strike on March 20, when a long crosscut tunnel from the 3,100 level of the Sunshine Mining Co.'s Jewell shaft broke into high-grade silver ore. The vein was reported to be 10 ft. wide, with the ore as rich as any found in the Coeur d'Alene silver belt. The entire width of the crosscut was reported to be mill ore. Drifting will continue and plans perfected for production. W. M. Yeamans, of Yakima, Idaho, in charge.

▶Coeur d'Alene district mining companies announced on March 20 increased wages of 25c. a day above the prevailing scale. Approximately 3,500 employees will benefit at the Bunker Hill, Coeur d'Alene Mines, Hecla, Star, Morning, Page, Dayrock, Sherman, and Tamarack properties. The increase raises the pay of miners to $6.50; muckers, $6; timbermen, $7; shift bosses, $8; surface labor, $5.75. The increase will result in an added distribution of more than $20,000 monthly in the district, making the Coeur d'Alenes the highest paid daily wage mining area in the West.

▶A field survey of a reported antimony deposit in Valley County, Idaho, suddenly was transmuted into a tungsten exploration. The Bureau of Mines started at that point to explore the reported occurrence of stibnite. Stripping operations on low-grade ore containing stibnite and gold were in progress. It was desired to determine the extent of the reserve from a strategic metal point of view. A bulldozing technic was first adopted for stripping the outcrop. This revealed a wide zone containing low-grade antimony ore. Core drilling was then necessary to determine further details. When the cores were examined the geologists were amazed to find a very considerable occurrence of tungsten. The assays show that considerable scheelite is present in these cores, and that conditions are favorable for recovery by flotation is probable. Commercial exploitation is anticipated promptly. Incidentally, the original purpose of the survey is also served. There is a huge quantity of low-grade antimony ore. This could be developed much more extensively if price were no object, as might be the case in an extended war period. Bureau officials are much more enthusiastic about the commercial prospect for tungsten.

▶The Yankee Boy mine of the Custer Consolidated Co., in central Idaho, reports a new strike of 2 ft. of high grade gold ore on the 600-ft. level. The ore is said to run 50 oz. silver to the ton. About 40 men are employed, producing about 70 tons daily.

▶Bunker Hill & Sullivan Mining & Concentrating Co. has just concluded arrangements for the installation of an H. H. sink-and-float section in its mill at Kellogg, Idaho. The unit will have a capacity of 1,400 tons per 24 hours and is being erected under license from the Sink & Float Corp., 9 Rockefeller Plaza, New York City, which controls the patents. The H. H. sink-and-float process is a method for pre-concentration of ores utilizing the buoyant effect of a suspension of galena in water to produce a heavy medium in which the mineral-bearing portions of the ore "sink" and the barren gangue elements "float."

▶Silver Summit Mining Co. stockholders have elected Harry P. Pearson, of Wallace, as president and manager; W. M. Yeamans, Yakima, vice president; Martin Nicholson, Wallace, secretary-treasurer; L. E. Hanley and H. J. Hull, Wallace, directors. The property has been idle since completion of a 1,400-ft. shaft, but negotiations are now under way for further development from the lowest level.

▶R. D. Leisk, general manager of the Sunshine Mining Company, stated recently that operations at the property will continue on an open-shop basis, with the question of union membership entirely optional with employees. The company recently announced it would comply with the Supreme Court ruling upholding an order of the NLRB to reinstate some 200 striking employees. Union efforts to make it a closed-shop mine prompted the strike, which in the final analysis may cost the company in the neighborhood of $300,000.

MONTANA

Manganese Nodule Output Expected to Start in June

Plant of Anaconda Copper Mining Co. will have annual capacity of producing 100,000 tons—Mike Horse Mining & Milling Co. contracts for new mill

▶In his annual report to stockholders, Cornelius F. Kelly, president of Anaconda Copper Mining Co., said that metallurgical research in the company's laboratories in Montana was successful in developing a method for the economic concentration of low-grade manganese ore. A section of the Anaconda concentrator is being remodeled for the treatment of the ores, and the resulting concentrates will be treated in a nodulizing plant now under construction at Anaconda, with annual capacity of approximately 100,000 tons of nodules assaying about 58 percent Mn. An agreement has been made to deliver to the Metals Reserve Co. 80,000 tons per year, for three years, and a contract has been executed for the sale of the remaining 20,000 tons. The ore comes principally from the Emma mine, owned by Butte Copper & Zinc Co., but under lease to Anaconda. Production of nodules is expected to start in June, 1941. The total output of copper by the plants of the Anaconda company

Union Potash & Chemical's
New Plant at CARLSBAD, N. M.
Uses THREE AKINS CLASSIFIERS

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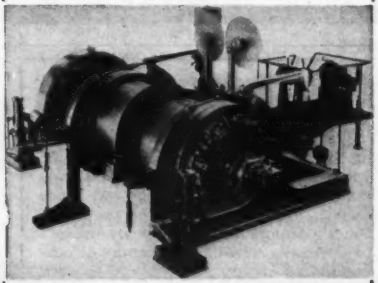
This picture shows an OTTUMWA double-drum hoist that has been serving for many long years. It is still in active service today, handling large tonnages with speed and safety on No. 1 shaft at Union Potash & Chemical Co.

You can see from the above what to expect from the newer later types of OTTUMWA Hoists—shown below. They incorporate new types of control and modern safety devices which reduce maintenance and assure long-time low-cost performance. Sizes from 3 h. p. Room Hoist to direct connected hoists of 2000 h. p. and larger. OTTUMWA Hoists secure maximum hoist value for users. Put your hoisting problems up to us —send for catalog on our complete line of mining equipment. Get facts that will benefit you.



OTTUMWA IRON WORKS

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aggregated 1,092,466,417 lb. in 1940. The metallic copper production, after deduction of 402,355 lb. (of which 321,516 lb. were from company mines), contained in byproduct materials sold to others, was 1,092,064,062 lb., obtained from the following sources: 267,715,581 lb. were treated on toll for the account of others; 50,007,944 lb. were produced from purchased ores, concentrates, and secondary metals; leaving a net production from the mines of the company and its consolidated subsidiary mining companies through copper plant operations of 774,340,537 lb. (253,037,590 lb. domestic and 521,302,947 lb. foreign), against 681,412,419 lb. (200,417,863 lb. domestic and 480,994,556 lb. foreign) in 1939, an increase of 13.6 percent. Total zinc production was 303,952,768 lb., of which 182,680,684 lb. were from purchased materials, toll zinc returnable 70,154,184 lb. and 51,117,900 lb. from the mines of the company. Lead output was 102,856,023 lb., of which 86,181,871 lb. were produced from purchased ores, concentrates, etc., and 16,674,152 lb. from the mines of the company. The company produced 17,920,814 oz. of silver in 1940, of which 924,645 oz. were treated on toll for account of others, 7,854,695 oz. were produced from purchased ores and concentrates, and 9,141,474 oz. were produced from company ores. Gold production amounted to 232,325 oz., of which 25,025 oz. were contained in materials treated on toll for the account of others, 163,916 oz. came from purchased materials, and 43,384 oz. from the mines of the company.

▶The Mike Horse Mining & Milling Co. has been formed to operate the Mike Horse mine, in the Heddleston district, 35 miles northwest of Helena. Al Wilkinson, Hennessy Building, Butte, is president, and the directors are C. C. Goddard, Jr., A. D. Falck, Jr., E. E. MacGilvra, Edgar Estel, and Robert Porter. The mine is held under lease and option. A contract has been let to build a power line from the Jay Gould mine, about 15 miles distant, and the Galigher Co. of Salt Lake, has contracted to build a selective flotation plant having a capacity of about 125 tons a day. The ore contains silver, lead, zinc, and copper. J. J. Frans is foreman of the Mike Horse.

▶The State Legislature has passed, and Governor Ford has signed, Senate Bill No. 5, which provides for payments of $30 a month to persons who have silicosis which results in their total disability to do manual labor. House Bill No. 354 appropriated $80,000 for the payments and administration of this program during the period from July 1, 1941, to June 30, 1943.

▶The Basin Montana Tunnel Co. has suspended mining and milling operations at its property on High Ore Creek, 7 miles northwest of Boulder. The shutdown was occasioned by lack of ore in the Comet mine. Examination of other properties has been under way for several years and is being continued. The operating staff under Dennis V. Ryan, superintendent, is being retained. Gerald Sherman, of New York, is the consulting engineer for the company, and Allan A. Ryan, Jr., is president, with offices at 1 East 57th St., New York City.

▶The C-G Gold Corp. is treating 100 tons of gold ore daily in its flotation plant at Radersburg. Most of the ore is coming from the Keating mine, which has produced more than $4,000,000 in gold. About 35 men are employed. L. J. Coady, of Radersburg, is president and general manager, and G. G. Griswold, Jr., of Butte, secretary-treasurer.

▶According to its annual report, the Golden Messenger Corp. yielded an income from operations in 1940 of $309,029.86 or $7 per ton from 44,152 tons treated, compared with $307,006.25, or $6.63 per ton, from the 46,268 tons treated in 1939. Mining and milling costs in 1940 was $5.48 per ton. Taxes, depreciation, and sundries claimed 52c. per ton in 1940, against 39c. per ton in 1939. At present 150 tons a day are being treated in the all-sliming cyanide plant near York. About 75 men are employed. J. C. Archibald, Lalonde Building, Helena, is general manager.

UTAH

Plant to Recover Zinc From Slag Being Built

Construction will be at Tooele by the International Smelting & Refining Co.—Elton Tunnel enters solid rock at 22,163 ft. from portal

▶International Smelting & Refining Co. has started construction of a $300,000 plant at Tooele to recover zinc from slag. Announcement of the plan to construct a plant patterned after that in operation at East Helena, Mont., for ten years was made by D. M. Kelly, of Butte, vice president and general manager of Montana operations of the Anaconda Copper Mining Co., while on a brief visit here March 12. Two hundred tons of molten slag from the Tooele smelter and 300 tons of cold slag from the dumps will be retreated daily in the slag furnace when completed, producing about 30 to 40 tons of zinc. A coal-pulverizing plant is to be installed to provide powdered fuel.

▶After passing through a brecciated zone, miners in the Elton tunnel of the National Tunnel & Mines Co. have entered a solid formation at a point 22,163 ft. from the portal. Less than 2,000 ft. remains to reach the objective of the adit, the 2,500 level of the Rood shaft of the Utah Apex mine in the Bingham district. A flood of water from the fissured zone apparently drained the water standing in the shaft.

▶Park Utah Consolidated Mines Co. has declared a dividend of 10c. a share, amounting to $209,186, payable on April 24. Net income for 1940 after taxes and depletion amounted to $291,318, against a net loss of $11,596 in 1939, when the company operated only part of

the year. O. N. Friendly is vice president and general manager.

▶ Bingham Metals Company has started cleaning up on the 1,100-level preparatory to starting operations after a five-year shutdown.

▶ Frank M. Maloney, of Reno, recently took a lease on a block of ground in the Wasatch Mining Co. property at Alta, Little Cottonwood Canyon. Operations, it is planned, will be started at once.

▶ The North drift of the Valeo Consolidated Mining Co. in its East Park City property is nearing the objective Valeo fissure, productive in early days.

▶ A short course in practical mining geology for prospectors opened at the University of Utah on March 18 and will continue for five weeks. This is an annual affair given through cooperation of the Extension Division of the University, the State Board for Vocational Training, the Great American Prospectors Association, and the Mineralogical Society of Utah. Professor R. E. Marshall will be in charge.

▶ Mine operators and employees testified March 18 and 19 at the conference held by the wage-hour division, United States Department of Labor, at the Temple Square Hotel, Salt Lake City, that, for the good of labor and industry, leasers must be considered as independent operators. Miss Dorothy M. Williams, of San Francisco, Calif., regional attorney for the wage-hour division, presided, assisted by Kenneth Montgomery, attorney of the Denver, Colo., wage-hour office. The hearing followed a decision of the Utah State Supreme Court last summer that a leaser is an employee of the company owning the mine and therefor subject to wage-hour, social security, and unemployment compensation laws. The "independent leaser" system, testified E. Frank Birch, of Eureka, Utah, representing Tintic Standard Mine leasers, "benefits the State, industry, and employment, particularly those skilled and experienced underground workers over 45 years of age."

Union labor officials took conflicting positions. Paul M. Peterson, president of the Utah State Federation of Labor, an A. F. of L. affiliate, urged operators and leasers to draw up written agreements defining leasers as independent contractors, thus eliminating the need of rulings under the fair labor standards act. R. O. Bunting, district president of the International Union of Mine, Mill and Smelter Workers (CIO), opposed any change or exemptions under the wage-hour act, which might threaten the minimum wage provision and reclassify miners. Rollo Kirk, of Tooele, described a new type of lease, known as the employment lease or guaranteed wage lease, used by some Utah mining companies. Under this type of lease, the leaser is paid the minimum mining wage of 30c. an hour provided by the fair standards act. The company in turn deducts this wage from any shipment of ore made by the leaser.

A. G. Mackenzie, executive secretary of the Utah Chapter of the American Mining Congress, urged the continuation of the leasing system, first because it offered the only practical

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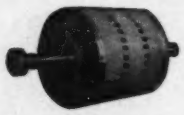

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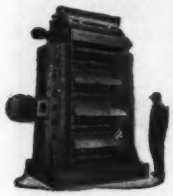

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▶UTAH

method of cleaning up ore in mining properties, which could not be done profitably by companies working with strict employer-employee relationships; and, secondly, because the leasing system assured proper and complete conservation of natural resources. Miss Williams explained that the conference was of the fact-finding type. Colonel Philip B. Fleming, wage-hour administrator, will issue as soon as possible an interpretation not intended to fit all cases, but necessary to determine whether a leaser is an independent or an employee.

▶M. G. Heitzman, manager of operations for the Silver King Coalition Mines Co., Park City, stated in his annual report for 1940 that exploration work in the Thaynes section amounted to 11,803 ft., and crosscuts were driven on five levels from the Thaynes Shaft and drifting started along several veins. During December, 1940, development work along a vein known as the A. O. began to show promise of developing into a considerable body of high-grade milling ore. Mechanical loaders were purchased and used in the Thaynes section. These loaders, along with automatic feed rock drills and other mechanical equipment, increased the speed of development advance in 8x8-ft. crosscuts and drifts, which were given at a cost only slightly more than the cost of driving 6x8 ft. drifts with hand mucking. Hot-milling equipment for sharpening detachable rock-drill bits was installed replacing grinding equipment used for the same purpose. This installation resulted in a substantial saving of bit costs.

▶At the Utah division of Kennecott Copper Co., operations in 1940 were at the highest average level for any year in the history of the property. More than 42,000,000 lb. of copper were produced in December, when the mills treated an average of about 80,000 tons of ore per day with mechanical smoothness and metallurgical efficiency. Many miscellaneous improvements and additions to equipment were made at the mine and mills. Three full revolving electric shovels were purchased for the mine and 200 cars of 100 tons' capacity for ore haulage. At the Copperton townsite 25 additional houses were erected, bringing the total at this location to 189. At the Arthur mill a dust-control system was installed in the coarse-crushing plant and a 200-ft. diameter Dorr thickener tank erected.

Capacity of Carteret Copper Refinery Being Increased

FOR A NUMBER OF YEARS the American Metal Co., together with the Scovill Manufacturing Co., of Connecticut, has been interested in the production and development of a superior grade of copper, known in the trade as OFHC (oxygen-free high conductivity copper). The demand for this product has now reached a point which warrants the provision of a larger producing capacity. Accordingly, such facilities are being installed at its Carteret refinery, in New Jersey, and it is expected that the new plant will commence operation during the coming summer.

COLORADO

Small Smelter Blown In Near Boulder

Plant of the Cobalt Mining Co. has capacity of 100 tons of sintered ore daily — Possibility arises for drainage tunnel for old mines in Leadville district

▶The Cobalt Gold Mining Co. has completed and blown in its new smelter at Degge Lake, 4 miles north of Boulder. The mine is 14 miles west of Boulder, and is said to have a large tonnage of ore broken available for the smelter. James Myers has been in charge of construction work. The ore is first crushed to about 1-in. size at the mine, then trucked to the smelter, where it is fed to rolls and then conveyed to the Dwight-Lloyd sintering machine. The sinter is sent to the furnace, which has a capacity of from 100 to 150 tons per day. The orebody occurs in a volcanic plug and the mine was formerly a gold producer. In 1939 development disclosed the presence of nickel at the 300-ft. depth with cobalt, copper, gold, and silver. Officers of the company are: Henry J. Von Wyl, president; Robert H. Wraith, vice-president; Ward Yeager, secretary; and Charles S. Vavra and A. Prazak, directors.

▶Mines on Battle Mountain with workings below the Roosevelt drainage tunnel have had the water level in each considerably lowered through the Carlton tunnel. In the Ajax property above the Carlton tunnel the water has been drained to the 26th level, and thus the first major objective of the drainage tunnel has been accomplished. Work has started on the 24th level of this mine, and when new hoist cables are received work on the 26th level will start.

▶The Colorado Assembly recently passed a bill for the purpose of driving a drainage tunnel for dewatering several old mines in the Leadville district. Tax-free bonds up to $2,750,000 are planned to be issued, but the bill provides that the people of the Leadville district must approve a $100,000 bond issue for preliminary surveying for the project. Federal aid may be sought on the basis that manganese or other strategic minerals might be made available.

▶Idarado Mining Co., in the San Juan district of Colorado, cut the Barstow vein at the Treasury Tunnel horizon, made connection with the old Barstow workings for purposes of ventilation, and did a limited amount of work on the Handicap and Barstow veins with negative results during 1940. Further expenditures preliminary to mining the Black Bear orebody (gold-silver-copper-lead-zinc) are not considered advisable at present, partly on account of the unfavorable tax position of new mining enterprises.

▶In the annual report of Climax Molybdenum Co., Colorado, Max Schott, president, reported to stockholders that the net result of operations for 1940, after all deductions except depletion of discovered increment, was a profit of $6,039,372.82, representing approximately $2.40 per share of 2,520,000 shares outstanding at Dec. 31, 1940, as compared with a net profit for the previous year of $10,309,586.37, representing $4.09 per share. As all foreign sales are now made against payment in this country before shipment, and as the company no longer carries stocks of concentrates abroad, the board resolved that the procedure of setting aside a sum of $10,000 monthly out of earned surplus be discontinued as of Jan. 1, 1941, and that the accumulated reserve be transferred to a general reserve account. Production during 1940 was slightly under 23,000,000 lb. of molybdenum contained in concentrates, compared with approximately 22,000,000 lb. during the year 1939. A letter, dated Dec. 28, 1939, advised stockholders of the cessation of sales of molybdenum to certain countries. As a result thereof sales to foreign countries for 1940 were approximately 64 percent less than in 1939. Domestic sales, however, showed an increase of 43 percent over those of the year previous. Total sales for the year 1940 were approximately 16,300,000 lb. of molybdenum, against 26,800,000 lb. for the previous year. Sales during the first two months of 1941 were approximately 2,800,000 lb. of molybdenum and while no means of forecasting sales for the remainder of this year are known, the indications are that the consumption of molybdenum in this country in 1941 will be considerably in excess of that of the year 1940.

Jarnagan Zinc Mine in Tennessee Starts Production

THE MASCOT property of the American Zinc Lead & Smelting Co. in Tennessee produced 24,010 tons of zinc concentrates in 1940, which compares with a production of 24,244 tons in 1939. The Jarnagan mine was not operated, but production will be started in April, 1941. Production from Mascot was restricted to actual demands for pigment purposes at the Columbus and Hillsboro plants. The new differential density method of concentration that the company has been developing at this property since 1935 operated with very satisfactory results, treating 913,099 tons of ore during the year. Prospecting for ore extensions consisted of 8,359 feet of underground diamond drilling, 6,513 feet of surface churn drilling, and 3,931 feet of drifts and raises. At the New Market-Grasselli properties of the company there were produced 15,966 tons of zinc concentrates, against 14,076 tons in 1939. Prospecting for ore extensions consisted of 2,048 feet of diamond drilling, 10,602 feet of surface churn drilling, and 3,282 feet of underground drifting. Options have been taken on adjoining properties on which prospect drilling is now in progress.

QUICKSILVER

New Idria Quicksilver Mine reduction plant during construction in 1917.

In a National Emergency this country is called upon to meet a demand for many of the so-called Strategic metals—metals vital to the defense and progress of our nation—metals which are on the "must" list for our most important industries.

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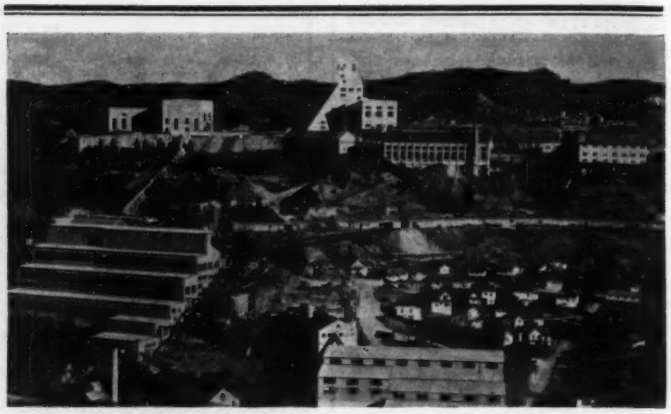


The new Yates shaft of the Homestake Mining Co., Lead, South Dakota, seen at the top of the photograph, gradually approaches completion to become the new hub of operations for the nation's largest gold producer

SOUTH DAKOTA

Homestake Mining Output Higher, but Income is Lower

Gross income for gold and silver production in 1940 4.56 percent below that of previous year

▶ Report of general manager Guy N. Bjorge at the Homestake Mining Co., Lead, S. D., stated that operations during 1940 were normal in all departments. Ore production from the mine was 1,433,737 tons, which was 2.41 percent higher than in 1939. The gross income for gold and silver produced was 4.56 percent lower than in 1939. It is expected that production for 1941 will be approximately the same as in 1940. Operating expenses exclusive of taxes were slightly lower than in 1939. Total taxes were $3,589,344.32, which is $456,832.21 more than in 1939. There are 397,603 tons of broken ore remaining in shrinkage stopes. Reserve of developed ore is 18,636,797 tons. As in previous reports, this includes the broken ore. Of the total reserve 7,974,600 tons are in the new ledge referred to in recent reports. This ore is materially lower in grade than that in the main ledges. Production from this ledge gradually increased and reached an average of 848 tons per day in December. It is expected that the average grade of all ore produced in 1941 will be substantially the same as that for 1940. Yates Shaft construction made good progress. Pilot raises were completed to the 4,100-ft. level, and the shaft is stripped to size and timbered from the surface to 50 ft. below the 3,350 ft. level. The hoists were placed in operation in May and have been continuously operated for shaft construction work since that month. The shaft has not yet been used for production, because hoisting at the Ellison Shaft is still possible. The winze from the 4,100-ft. level was sunk to the 4,700-ft. level and drifting on the 4,700-ft. level was begun. Precipitation in 1940 was again subnormal. Stream flow was the lowest on record, with correspondingly low output from the hydro-electric plants. The new sawmill at Spearfish was practically completed. Sawing began in the last quarter of the year and sawmill operation at Moskee, Wyo., was suspended. Operating economies are indicated in this new modern sawmill.

ALASKA

Active Dredging Season Expected in 1941

Yukon Consolidated Gold Corporation will exploit new areas as well as old placers —Ore extension found on 500-ft. level of Hirst-Chichagof Mine

▶ W. H. S. McFarland, manager, estimates that Yukon Consolidated Gold Corp., Ltd., enters 1941 with approximately 89,000,000 cu.yd. of available ground containing gold valued at $41,000,000. The company has 1,600 placer claims and six mining leases. On one-third of the ground which has not heretofore been mined four dredges will operate this year. Six other dredges will be operated in worked-over areas. Three of the company's dredges are equipped with 16-cu.ft. buckets and the others of 7 and 5¾ cu.ft. The company's electric power comes from its plant of 15,000 hp. on the Klondike River, 28 miles from Dawson. All operations are suspended during the winter months.

▶ The building program at the Gold Cord mine, in the Willow Creek district, has been completed, according to Elmer Sinco, foreman. During the last five months a new mill, two bunk houses, an office, a warehouse and a 100-ton bunker have been erected and two new diesel engines installed. The mine was shut down seven weeks while equipment was being transferred from the old to the new mill.

▶ Forty miles of snow road were built, paralleling the Richardson highway, in order to transport 800 tons of equipment and supplies during the winter for the property of the Johnson and Brinker Syndicate, on Caribou Creek, 95 miles southeast of Fairbanks. The syndicate's

dredge was built in San Francisco and the shipment included a steam boiler and a large quantity of equipment in addition to the dredge parts. It was necessary to cross the Salchaket River three times. The equipment is expected to be in place and ready for operation early in April.

▶Paul Sorenson, manager of the Hirst-Chichagof gold mine, in the Juneau region, reports that the drift on the 500-ft. level has passed into the rich, recently discovered K oreshoot and that the mine's future seems exceptionally good.

IRON COUNTRY

72,000,000 Tons Iron Ore Expected to Be Shipped

Ore carriers and mine operators ready for the largest shipping season in the nation's history from the Lake Superior district

▶Observers in the Lake Superior iron mining districts expect the busiest season in history. Some have predicted that 72,000,000 tons of ore will be moved from the Upper Lakes to Lower Lake ports during 1941. In 1940, 63,352,768 tons were shipped. Early in April some freighters of the Inland Steel Company left for Upper Lake ports, as did eight freighters of the Cleveland-Cliffs Iron Co. Coast Guard cutters opened the necessary channels through the ice. Lake Erie navigation was opened on March 30.

Marquette Range

▶The Inland Steel Co., Ishpeming, Mich., recently completed modernization of its change house. New lockers have been installed and the layout is designed for comfort and efficiency. The concrete floor has been finished with an iron oxide paint that is waterproof and rustproof. Fritz Olsen, mine superintendent of the Morris mine, designed the new change room.

▶A record for early spring operations was made at mines in Negaunee, on the Marquette range, when loading of iron ore started during the week of March 24.

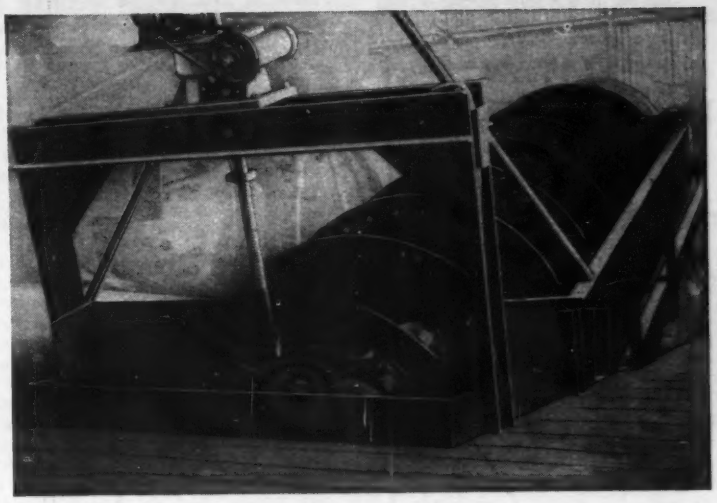
Menominee Range

▶Work on the new steel headframe at the Sherwood mine of the Inland Steel Co., near Ishpeming, is advancing rapidly and the shaft has been sunk below 400 ft., with the level station at that horizon now being cut. R. D. Satterly is Menomenee range superintendent of the Inland Steel Company.

Mesabi Range

▶Stripping operations at the Canisteo mine of the Canisteo Mining Co., Coleraine, Minn., have been completed. About 1,500 cu.yd. of overburden were removed by power shovels, and the undertaking was considered one of the largest earth-moving jobs on the Mesabi range.

A WEMCO 60" SCREW CLASSIFIER



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BIG DREDGE Operated by NATOMAS Uses 18 Pan-American Jigs

Manhattan Dredging Company's big boat near Tonopah, Nevada, operated for the owners by the Natomas Company, uses 18 Pan-American jigs for gold recovery.

Primarily a jig recovery operation, the Manhattan dredge has 2 banks of eight 42" by 42" Pan-American Placer Jigs to work the 12,000 cy. handle, with two additional Placer Jigs of the same size for cleaners. The entire jig assembly and installation was designed by Pan-American engineers in cooperation with the dredge builders.

Today more and more dredges, draglines and doodlebugs are being equipped with Pan-American Jigs, because Pan-American metallurgical tests in the field accurately predict *in advance* what the jigs will recover. Placer jigs for roughers. Pulsator jigs for cleaners or for roughers on small operations.

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TRI-STATE

Mines Maintaining Steady Zinc Production

Output of around 9,000 tons zinc concentrate continues each week — Eagle-Picher Mining & Smelting Co. starts new block in zinc smelter

▶ Several developments under way throughout the Tri-State district offer some assurance that the present production rate of around 9,000 tons of zinc concentrates weekly will be maintained this year at the prevailing price of $48 a ton. Requisite for much additional output will be a higher price.

▶ Eagle-Picher Mining & Smelting Co. has started the sinking of a new shaft on the company's Gordon lease, west of Monarch and just south of the Kansas-Oklahoma state line. A steel derrick and 400-ton hopper has been moved from the Grace B. lease, northwest of Treece. The company has done considerable drilling on the virgin 50-acre tract which adjoins the old Commerce Wilbur lease, in Kansas, on the south. Another shaft is contemplated in the near future near the south line. Ore will be hauled to the company's Central mill.

▶ The F., M. & S. Mining Co. has completed a new shaft on the Jones-Covert land, a 20-acre tract west of Baxter Springs and a short distance south of U. S. highway 66. R. R. McCullaugh, of Baxter Springs, is in charge of operations.

▶ Madison Mining Co. is sinking a new shaft on the Thomas land, northeast of Hockerville, in Kansas, according to Dewey Simms, of Baxter Springs, superintendent. The shaft, which is just northeast of the company's mill, will be put down to the 105-ft. level, where previous drilling showed a zinc-lead ore deposit.

▶ A new block of 800 retorts started operations in March at the Henryetta, Okla., zinc plant of the Eagle-Picher M. & S. Co., according to D. C. MacKallor, of the Joplin offices of the company. The new block, which will make a total of seven at the plant, will increase the smelting capacity approximately 16 percent.

▶ Oldham Mining Co. is working a deposit of zinc ore from a shaft reopened and dewatered on the Morrison land, a mile northwest of Baxter Springs. Ore is being trucked to the Guaranty M. & R. Co.'s mill at Hockerville for treatment.

▶ A new shaft is being sunk and several old ones have been reopened in the southeast section of the Waco mining field, according to Cleve Craig, superintendent of the R., H. & G. Mining Co., which is subleasing to different groups of prospectors. Ore will be treated at the company's mill on the old Barnsdall No. 3 lease near the Kansas-Missouri state line.

▶ Among the small mills scheduled to start operations this spring are those of the Capital Mining Co., at Stotts City; Romo Mining Co., near Lincolnville; Smoky Hill Mining Co., north of Commerce; Mid-western Mining Co., east of Wentworth; Roan Bull Mining Co., west of Picher; St. Louis Mining & Milling Co., at Thoms Station; and the Sciota Milling Co., southeast of Webb City. St. Louis Smelting & Refining Co. may resume operations at its No. 9 plant west of Waco, and Kansas Explorations, Inc., probably will start its new mill, now under construction on the Snapp land, by late spring or early summer.

▶ Harris Mining Co., an Arkansas corporation, is dismantling the Ritter mill, on the High Five lease at Waco, preparatory to the rebuilding of the plant on the Scott, Phelps, and Scott lease, north of Aurora, Mo., where the company has done considerable development work during the last six months. Wayne Stair, of Joplin, vice president, is in charge of operations. Other officers are Earl A. Harris, of Rogers, Ark., president-treasurer, and Loren J. Ely, of Bentonville, secretary.

St. Joseph Lead Company Has Large Output in 1940

CLINTON CRANE, president of the St. Joseph Lead Co., in his annual report to stockholders, stated that in 1940, for the first time since 1930, the company's mines were operated on a full-time basis throughout the year, resulting in the largest production of lead and zinc concentrates since that time. The sales, which were greater than in any previous year in the company's history, also exceeded production, and, as a result, the finished stocks were again reduced. Although the demand for lead is in excess of the United States productive capacity, the supplies from properties outside of our country should be sufficient to insure against any shortage. As a large percentage of the world zinc-smelting capacity is in the British blockaded areas, the present demand for zinc metal is considerably in excess of the available smelting facilities; the industry, however, has taken constructive steps to increase output, and it is hoped that the immediate problems of supply may be minimized through cooperation between consumers and producers. The Southeast Missouri properties were operated on a full-time basis during the year, as were those of the Mine La Motte Corporation (50 percent owned). The development work during 1940 proved entirely satisfactory. The two zinc-mining properties in northern New York were also operated at full time, and the development showed satisfactory results. At the smelter and sulphuric acid plant located at Josephtown, Pa., full-time operation was maintained. The Cottrell precipitator to handle fumes from the sintering machines was completed in August. The 1940 capital expenditures at this division amounted to $836,772.70. A 25 percent increase in acid and zinc metal capacity will be available in the first quarter of 1941. The Ritz mine, in Oklahoma, and the Jarrett mine, in Kansas, properties of Kansas Explorations,

Inc. (100 percent owned), were operated throughout the year and steps were taken to place in production in the first half of 1941 the Snapp mine of this company. The Block "P" Lead and Zinc Mine, at Hughesville, Mont., remained closed through 1940 and an early reopening is not contemplated.

National Lead Co. Buys Titanium Bearing Magnetite Deposit

THE old McIntyre iron mine, at Tahawas, N. Y., has been purchased by the Titanium Pigment Corp., subsidiary of National Lead Co. Rehabilitation of the mine, which is in Western Essex County, New York State, is under way and a plant is being designed to treat the titanium-bearing magnetite. The property has been shut down for the last 30 years.

CANADA

Beattie Gold Mines Plan Exploration

Search will be made along porphyry belt —C.I.M.M. holds annual convention in Montreal

▶Many Canadian mining men, prominent in the country's industry, attended the fourth-fifth annual general meeting of the Canadian Institute of Mining and Metallurgy, held in Montreal, March 10, 11, and 12. Under the Institute president, George C. Bateman, an elaborate program of business, education, and entertainment was prepared. Prominent among the guests and delegates from the United States were Dr. John F. Thompson, New York, executive vice president, International Nickel Co. of Canada, and president of the Mining and Metallurgical Society of America, and Donald B. Gillies, Cleveland, Ohio, vice president, Republic Steel Corp., and past president and official delegate of the American Institute of Mining and Metallurgical Engineers. Addresses were delivered by W. M. Losee, chief, Mining, Metallurgical and Chemical Branch, Dominion Bureau of Statistics; Dr. C. K. Leith, consultant on minerals, Advisory Committee to the Council of National Defense, Washington, D. C.; H. D. Scully, Steel Controller for Canada, and J. McG. Stewart, Coal Controller for Canada (National Defense); Max W. Ball, president, Abasand Oils Ltd. Anglo-American Responsibilities; and (at the annual dinner) by Donald B. Gillies, Dr. John F. Thompson, and Gilbert Jackson. Several interesting technical papers were discussed, among them being, "The Rockburst Problem," by Dr. F. B. Langford; "Strategic Metals and Minerals in Canada," by W. B. Davis and G. C. Monture; "Caving Replaces Open Pit Mining at the Asbestos Mines, Johnson Company, Thetford Mines, P. Q.," by the staff; "Development of the Athabasca Oil Sands," by Max W. Ball; "Ore Dressing Laboratories," School of Mines, Laval University, Quebec, by C. E.

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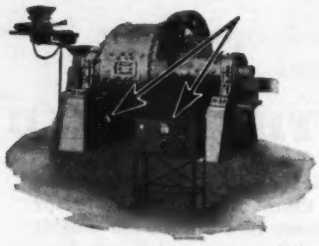

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▶CANADA

Rogers. W. G. McBride, professor of mining engineering, McGill University, Montreal, was elected president of C.I.M.M. for 1941.

Quebec

▶A large-scale exploration program has been laid out for 1941 by Beattie Gold Mines, according to an announcement by the president, Thayer Lindsley. After producing bullion worth more than $14,000,000, the Beattie ore reserves are good for another seven years and have an estimated gold content of $22,000,000. It is now proposed to search for other lenses along the 15,000-ft. belt of porphyry that includes the adjoining properties of Donchester Mines and Central Duparquet Mines (formerly the Dumico Gold Mining Corp.). Beattie's general manager, W. B. Maxwell, reports record production in 1940 amounting to $2,754,916.

▶Plans have been announced for reopening the property of Payore Consolidated Mines, located east of the Lamaque and Sigma and two miles north of the Senneterre-Rouyn branch of Canadian National Railways. A 50-ton, electrically operated mining plant is installed. An ore estimate by Alton C. Bray, consulting geologist, shows 130,000 tons averaging $9.86 a ton after allowing for dilution.

▶The most profitable year for Normetal Mining Corp. shows net operating profit of $259,901, but a loss of $27,588 after taxes, depreciation, and deferred development. Zinc concentrates are shipped to a smelter in the United States and copper concentrates go to Noranda. J. A. Little is mine manager.

Ontario

▶Jerome Gold Mines, controlled by Mining Corporation of Canada, expects electric power from the Ontario Hydro to be turned on in April. Foundations are being built for the 500-ton mill and shaft sinking is in progress to open two more levels, at 650 and 800 ft. J. H. C. Waite is president.

▶M. W. Hotchkin, manager of Toburn Gold Mines, Premier subsidiary, reports new records for 1940 in tonnage mined, production, and operating profits. The internal shaft has been deepened from 1,850 to 2,511 ft. and it is now proposed to develop a strong vein structure that is located north of any other known ore occurrences.

British Columbia

▶Island Mountain Mines Co., Ltd., Cariboo district subsidiary of the Newmont Mining Corp., reports that after provision for taxes and depreciation, net profit for 1940 was $216,126.24. No charge was made for depletion, as, according to President F. W. Guernsey, the item "Mining Claims and Development" is now carried on the books at $84,915.18, a figure considered to be less than actual value. A total of 49,229 tons of ore averaging 0.445 oz. gold per ton were delivered to the mill, from which 20,961 oz. of gold and 3,131 oz. of silver were recovered for an average realization of $16.41 per ton. Cost of production during the year averaged $10 per ton. T. H. Munn, formerly manager of the property, resigned in February and has been succeeded by J. A. Pike.

▶Drifting on the "B.C." vein at Cariboo Gold Quartz Mining Co.'s property from the point where the vein was intersected by the extension of the 15-Main crosscut has exposed 50 ft. of quartz averaging 4 ft. in width and assaying approximately half an ounce of gold per ton.

▶An agreement has been entered into by Premier Border Gold Mining Co., Ltd., and Silbak Premier Mines, Ltd., whereby the latter company will take over and develop Premier Border's Northern Light property, which is situated adjacent to the Silbak Premier property in the Portland Canal district.

MEXICO

Ore Being Smuggled Through Mexican Ports

Government investigation confirms report of large-scale ore robberies—Strike settled at Pachuca

▶The federal attorney general's office has announced that its preliminary investigation of wholesale pirating of ore on privately owned and government properties proves these charges to be true. Much of this thieving, alleged to be directed by foreigners, is in the Pachuca district, Hidalgo, but it is also being done in other parts of Mexico. The attorney general's investigators have found that much of this stolen ore is being smuggled out of Mexico to destinations that have not as yet been ascertained, from Mexican Pacific ports.

▶Cia. Real del Monte y Pachuca, S. A., Pachuca, Hidalgo, H. M. Kuryla, Las Cajas, Pachuca, Hidalgo, managing director, has apparently settled its labor difficulties with the payment through the federal board of conciliation and arbitration of 650,000 pesos ($125,000) to its workers.

▶Moctezuma Copper, Nacozari, Sonora, is faced with a queer economic situation resulting from the problem of the numerous miners who flocked to its workings because it was reported that the company intended to expand its operations. These miners are constituting a grave problem for the Nacozari authorities. The company says it cannot employ them because of its depressed business. Reports in mining circles are that increased taxes have made conditions difficult for Moctezuma.

▶The national miners union has protested against amendments to the federal labor law which President Manuel Avila Camacho sponsored and which Congress has approved. Though the

congressional committee that examined these measures declared that they protect both employees and employers, Agustin Guzman V, secretary general of the union, asserted that the union considers the modifications not altogether to the advantage of labor. Many other labor organizations have advised the government that they approve these amendments.

▶ Lic. Ignacio Garcia Tellez, the labor minister, and Fol. Alfredo Chavez, Governor of Chihuahua, have offered to render good offices toward bringing to a happy conclusion conversations American Smelting & Refining is conducting with the national miners union for new contracts for the 7,000 workers of its Chihuahua units. W. Lord, general superintendent of the units, is representing the company at the talks.

▶ The stepping down of Lic. Vicente Lombardo Toledano, Mexico's labor czar, as head of the Confederation of Mexican Workers, is seen as a favorable indication for prospects of improved relations between labor and industry.

SOUTH AMERICA

Bolivian Tin Mines Require Mechanization

Inadequate labor supply retards expansion of country's national resources—Copper exports from Braden mine, in Chile, increasing

▶ Expanding American and British demand for tin is expected to keep Bolivia's tin-mining industry operating at peak levels for some time to come, according to a report from the American Consulate in La Paz. The widening market for other minerals, such as antimony, wolfram and asbestos, indicates that Bolivian production in these lines will increase. Notwithstanding the fact that Bolivia's labor supply is notably inadequate, low wages have prevailed in the mining industry, and as a result few of the local tin mines, even the larger ones, have mechanized their operations to any marked extent. An outstanding exception to this rule is the Llallagua, the world's foremost vein-tin mine. Indications are that any important expansion of Bolivian tin mining will depend largely on greater mechanization, and the favorable results obtained at Llallagua in improving mining and milling methods will probably encourage similar practices in many other tin mines. If an assured market for tungsten and antimony is guaranteed, it is likely that a considerable amount of mechanization must take place in these mines also.

CHILE

▶ During the first half of the year production at the plant of the Braden Copper Co. in Chile, was maintained at about 11,500 tons of copper per month. It was reduced to 6,000 tons following the collapse of France and in the last quarter was increased again to approxi-

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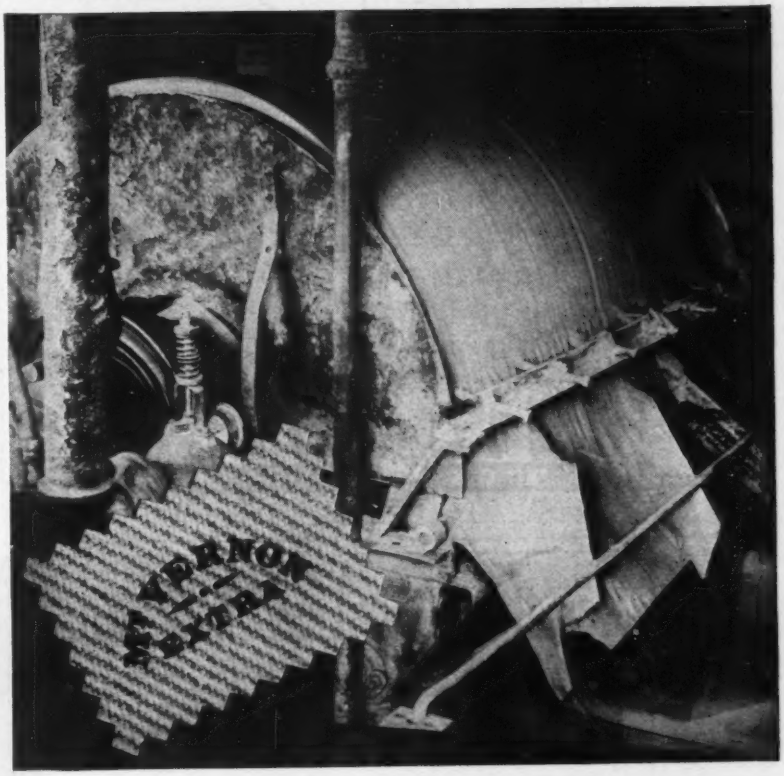

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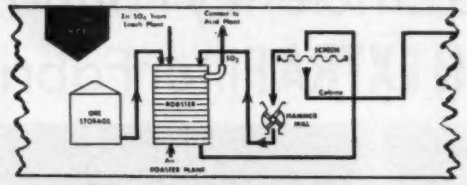

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▶SOUTH AMERICA

mately 10,000 tons per month. Ore mined and treated during the year amounted to 6,134,643 dry tons containing 2.14 percent copper. Concentrates shipped to the smelter assayed 32.27 percent copper and there were produced from the smelter 240,714,866 lb. copper. This copper output compares with 260,939,595 lb. in 1939 and 318,169,808 in 1937, the latter having been the record year of production for the property. The markets for Braden output were further limited by changing war conditions. Although foreign outlets for copper have been lost, the United States promises to be a large consumer of Chilean copper in 1941, as domestic mines cannot supply the total requirements needed for civilian consumption and the armament program now under way. Expenditures for welfare purposes continued. An idea of the magnitude of the housing problem may be gained from the fact that some 18,000 people must be cared for and schools, as well as recreational and other facilities, provided and maintained. In 1940 the enlargement of No. 1 shaft was completed and a new modern hoist installed. This improvement will greatly facilitate the movement of men to and from work and make it possible somewhat to better the living conditions for employees at the mine. The Pangal concrete-lined pressure conduit was completed and some minor alterations were made to the crushing plant. Though there were no strikes during the year, labor conditions were less satisfactory than usual, due largely to causes extraneous to operations. Operating costs were greater because of increased import duties, railroad rates, cost of new social laws and miscellaneous taxes in Chile, and also resulted from higher ocean freight rates on mining supplies and copper shipments.

AFRICA

Gold Mines Expect Higher Taxation

Witwatersrand producers of the metal are estimated to contribute another £1,000,000 to war effort—Rhodesian copper mines are operating at capacity, with no labor shortage

▶African gold mining companies are expecting a still further increase of taxation to be called for in the forthcoming British budget. There is, however, no reason to expect any more opposition than can be expressed in a mild protest. This will be in response to the habit of protesting against increase of taxation, as the mining companies have the financing and winning of the war as much at heart as the colonies, dependencies, and protectorates of the British Government have all over the world, and all of the latter, including small islands in remote parts of the world, are voluntarily sending large contributions to the war fund. Higher taxation will come at a time when the gold-min-

ing companies are experiencing far greater prosperity than ever before and so will be a burden easy to carry. It is estimated that the Witwatersrand gold mines will be called upon to contribute a further £1,000,000 in the coming year. This would be only about 5 percent of the amount they paid last year in dividends. The copper mines of Northern Rhodesia are paying approximately the same proportion of their net earnings and in addition making large concessions in the price at which they sell their product to the government. *The Financial Times* tabulates seven tin-mining companies to show that they are paying from 40.2 percent to 59.6 percent of their total profits in taxation. It is taken for granted that these high payments must continue for the duration.

▶ No shortage of mine labor has resulted from the arrangement by which Northern Rhodesia is co-operating with Southern Rhodesia and Nyassaland in supplying a considerable number of natives for military service. The copper mines are being operated at full capacity and are producing record outputs.

▶ The British Government is to purchase 126,000 metric tons of Union Minière du Haut-Katanga copper. This has been arranged for in an economic agreement effected between the governments of Britain and Belgium. It is understood that payment is to be made in sterling, which currency will become the money of the Belgian Congo for the duration of the war. Other Belgian Congo products are to be similarly purchased, including tin, gold and radium.

AUSTRALIA

Favorable Developments Reported in Bendigo

Results of prospecting in Victoria Province encouraging—Bet-Bet deep-lead gold property being reopened

▶ The Australian price of copper has been raised from £76 per ton, at which it has been fixed since Feb. 16, 1940, to £78-10- per ton, effective Feb. 7. Local producers will continue to receive the previous price of £76, and the difference of £2-10/- will be used to offset losses incurred in the importation of higher priced metal from abroad, which has become necessary to meet the greatly increased demand, largely for defence needs. Ways and means are being considered for raising the local production, at present 18,000 to 20,000 long tons annually, to lessen the dependence of the country on imported supplies.

Western Australia

▶ Some mines at Bendigo have had favorable developments recently. South Deborah at the 380-ft. level has cut a western back at 18 ft. from the shaft, showing gold, and Central Deborah, working farther north on the same line, has intersected an eastern back at 533 ft. during shaft sinking. A major west-dipping fault, the first cut in the mine, has been met in the South Virginia

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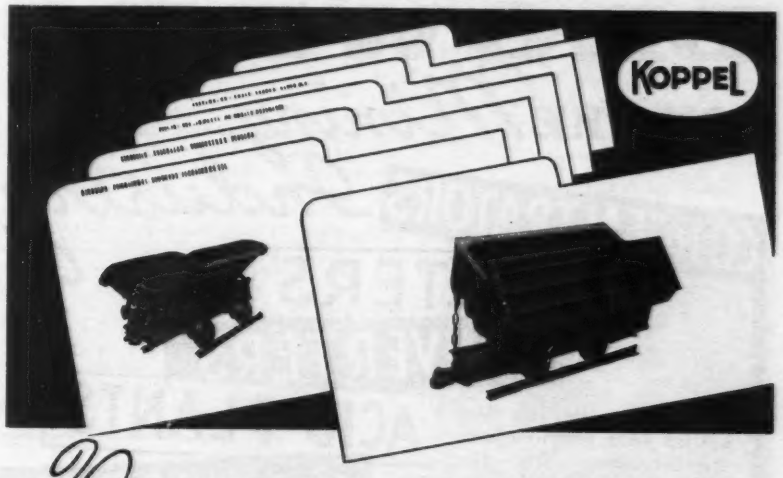

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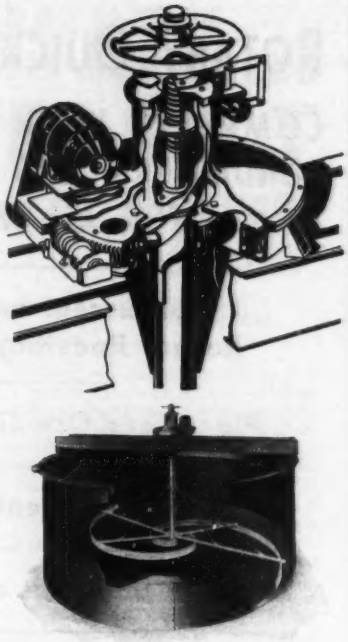

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▶AUSTRALIA

mine, and from the little prospecting done so far it appears that large bodies of gold-bearing quartz may be found allied with the fault. Another fault, with which is associated quartz carrying visible gold, has been found in the Central Napoleon mine. Golden Carshalton, N. L., has met a new spur formation, carrying high-grade ore, in the No. 3 level at 105 ft. south. A new company, Carshalton North, N. L., is being formed to take over ground which was pegged last year, on the northerly continuation of the Carshalton line, 3½ miles northwest of Bendigo, by the Ironbark, Ironbark South, and Hercules companies.

▶Another attempt may be made to reopen the Bet-Bet deep lead, on which Talbot Alluvials, Ltd., carried on operations for some years without successful results. It is reported that W. Baragwanath, director of the Victorian Geological Survey, has investigated the property and considers that the venture should be profitable if Australian deep-lead methods are applied. Deep-lead exploration is also being carried out at East Metcalfe, where boring is in progress in an endeavor to locate the rich Campaspe lead.

▶New Providence Gold Reefs, N. L., has been formed to reopen the old Providence mine at Yea, east-central Victoria, from which small tonnages of rich ore were taken over 40 years ago.

▶The attention of overseas interests is being directed to the line of lode on which the Blue Spec mine, at Nullagine, is situated, according to W. Harvey, chairman of the Blue Spec company. Mr. Harvey believes that there is a prospect of developing some mines on the long outcrop. The Blue Spec has recently had an encouraging result in No. 9 bore, which proved the widening of the rich north parallel reef at a depth of 370 ft. Ore reserves at June 30 last were estimated at 9,400 tons of proved and probable ore of 18.9 dwt. assay, and 5,400 tons of possible ore valued at 15.5 dwt.

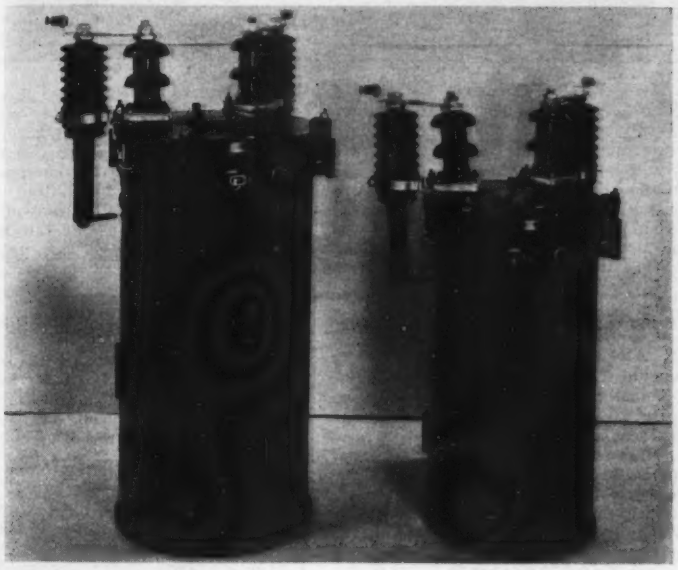
Queensland

▶First yield from the new plant of Normanby Tin, N. L., operating near Cooktown, was 4 tons 4 cwt. of tin oxide from the sluicing of 4,800 cu.yd., an average of nearly 2 lb. per cubic yard. Prospects of the company are viewed favorably by G. M. Reid, an independent tin-mining engineer from New South Wales, who recently visited the property.

▶F. W. Cuthbert is opening up the Golden Bar mine, at Georgetown, North Queensland, which has been operated at intervals for the last 50 years, 1,064 tons of ore, mined in small parcels, having returned 1,124 oz. gold. Present plans call for the sinking of the shaft to a depth of 400 ft., with plats cut at 100-ft. intervals. The property is being equipped with winding plant and a 370 cu.ft. per min. Ingersoll-Rand compressor, direct coupled to a Waukesha-Hesselman diesel engine of 109 hp.

EQUIPMENT NEWS

New Smaller Transformers with Greater Flux-Carrying Capacity



New Hipersil distribution transformers (right) are as much as 25 percent smaller and lighter than conventional units. Shown here are 10-kva. transformers

FOR OUTDOOR USE on distribution systems, a new line of smaller, lighter transformers has just been announced by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. Available in sizes of from 1½ to 500 kva. for voltages of 2,400, 4,800, and 7,200, these new units have cores made of Hipersil (trade mark registered by W.E.&M. Co.), a new magnetic steel which has a flux-carrying capacity about one-third greater than that of ordinary silicon steel. This facilitates reductions in size and weight as much as 25 percent in some sizes. The simple magnetic circuit of a Hipersil transformer makes ventilation of the winding easy, so the temperature gradient between coils and oil can be reduced. As copper losses for a given load are decreased, the quantity of heat generated in the winding is lessened, and a greater short-time overload can be carried without exceeding safe operating temperature. A typical distribution transformer using the new magnetic material is said to carry 2¼ times full load for an hour, but an older transformer of the same rating carried only 1.9 times full load for the same period and same temperature rise. Reduced impedance, especially in units smaller than 25 kva., has improved voltage regulation on the average about 10 percent.

In single-phase units maintenance is simplified by a new type of wound core, fabricated into two solid pieces that are strapped together around the coils. If coils need to be replaced, the operation can be preformed quickly by removing the strap and lifting one half of the core out of position. Three-phase units have stacked cores similar to those used in conventional transformers in many industries.

Automatic Car Holder

PORTABLE Lamp & Equipment Co., 78 First Ave., Pittsburgh, Pa., announces its automatic car holder, designed chiefly to increase safety and efficiency in mine car gathering trips. It consists of a base casting, for securing it to ties, a holding member, and a counterweight which controls position of the holding member. In use, the holding member is placed in a vertical position and the car is pushed against it, causing it to fall horizontal and allowing the car to pass over it. After the car has passed, a counterweight causes holding member to return to the vertical, thus holding car. This process is repeated for every car until entire trip is gathered. The new holder is said to be ruggedly constructed and easily installed and removed by means of standard track bolts.

Plastic Valves Replace Aluminum in New Respirator

THE MINIATURE, Dupor No. 1 nuisance-dust respirator recently announced by H. S. Cover, South Bend, Ind., is reported to have been made lighter by replacing aluminum valves with molded plastic ones. The total weight of entire unit is said to have been reduced to under one ounce. This handy respirator, designed to fit over nose only, is held in place by elastic ear bands, and can be worn as conveniently as a pair of glasses. Nose piece is of soft rubber with 9 sq.in. filter pad. New plastic valve arrangement keeps stale air from backing up inside filter pad and expels breathed air instantly.

New Lubricated Packing

A HIGH-PRESSURE spiral packing with the outer layer impregnated with lubricant forced into the packing by a special hot-pressure process is announced by Greene, Tweed & Co., 101 Park Ave., New York, N. Y. The lubricant used is genuine graphite grease. Referred to as Palmetto high-pressure spiral packing it is said to be made of closely woven asbestos cloth with center block laid up against a flat strip of heat-resisting, resilient red rubber. The cover or wear face is firmly bonded to the center to make a strong square cornered packing. Construction combines ruggedness and resilience which is said to withstand misalignments and impact shocks, together with effective and lasting lubrication, which reduces wear on the rod of shaft and prolongs the life of the packing.

Steel Tapes

THE LUFKIN RULE CO., Saginaw, Mich., announces a full line of engineers' pattern chrome-clad steel tapes, all being only ¼ in. wide. The tapes are chrome plated and the markings are easy to read, and durable, being jet black on a chrome-white surface. The chrome plating makes these lines rust-resistant and gives them a surface that is hard, smooth, and easily kept clean. These tapes are offered in two weights, the sturdy medium and the extra heavy, both available with marked feet, 10ths and 100ths feet, and feet, inches, and 8ths.

Largest Shovel in World

The largest shovel in the world was recently put in operation at the Tecumseh Coal Co., Tecumseh, Ind. Built by the Marion Shovel Co. it weighs 3,200,000 lb. and has a capacity of 35.6 cu.yd. Electric equipment, furnished by General Electric, totals 3,850 hp. Possible maximum take-out of the shovel is estimated at one million cubic yards per month.

Users tell us that the light weight Morenci Safety Belt is so comfortable and easy to adjust that their men not only wear them but *use* them as a matter of habit. It weighs but 25 ounces, complete... yet will outwear and outhold most heavier, less flexible belts. *Continuous* tough strands run the entire length of the belt... unbroken by fastening holes or grommets. Adjustable "D" ring is readily placed in any comfortable position...but once set it *stays put.* Send for Bulletin 4064... it simplifies safety buying. E. D. Bullard Company, 275 Eighth Street, San Francisco, Calif. B-4

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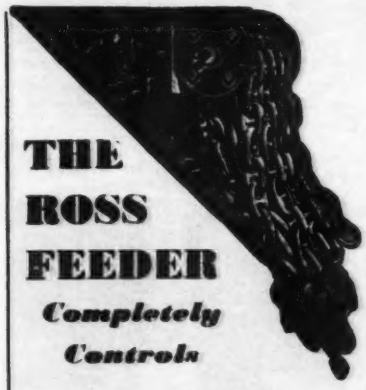

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Vibrating Conveyors

A NEW VIBRATING CONVEYOR and feeder known as the Free-Flow was recently announced by the Standard Transmission Equipment Co. of 416 West 8th St., Los Angeles, Calif. The unit is said to operate on the lift-throw principle, with the motion of the trough becoming increasingly horizontal with the progress of each cycle, thus imparting to the conveyed material a gentle forward motion. This motion is so designed as actually to suspend the mass in the air with only momentary contact with the trough on the upward period. By means of variable-speed control of the rate of oscillation of the trough, volume can be controlled as desired, and the material can be conveyed up inclines to 15 deg. from the horizontal.

New Tri-Clad Capacitor Motor

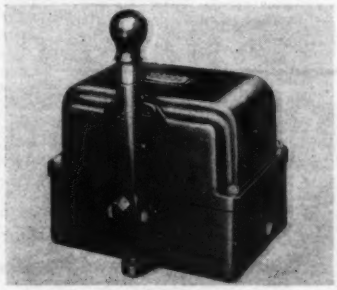
AS AN EXTENSION of its recently announced line of new polyphase induction motors, General Electric Co., Schenectady, N. Y., now offers a new Tri-Clad capacitor motor designed to meet a large number of varied industrial applications. Like the polyphase Tri-Clad motor, this capacitor motor features modern appearance and better mechanical and electrical protection, as well as protection against operating wear and tear.

The new capacitor motor may be obtained with either ball-bearing or sleeve-bearing construction, and is available in two types, Type KC and Type KCJ. The Type KC is designed particularly for applications requiring moderate starting torques such as fans, blowers, and centrifugal pumps. The type KCJ is designed for compressors, loaded conveyors, reciprocating pumps, and any other applications requiring high starting torque.

In both of its forms, the capacitor motor is said to incorporate all of the protective features of the Tri-Clad line.

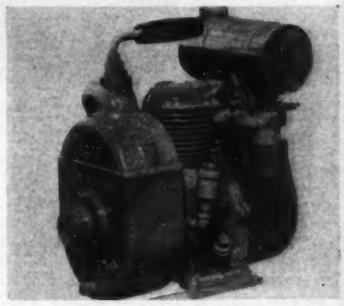
Cam Operated Controller

SPEED UP OF PRODUCTION, through reduced fatigue, is the result claimed for the new line of cam-operated, mill duty controllers announced by Cutler-Hammer, Inc., Milwaukee, Wis. Ease of



operation with positive feel of all speed positions is obtained by using an adjustable compression type of star wheel spring.

Available in two speed, three speed, and multi-speed types, the controllers are said to be ideal for mill auxiliaries, crane hoist, bridge, and trolley applications. Features of this new equipment include contacts that are vertical, double break, silver to silver, and the camshaft operates on ball bearings sealed against dust. Optional features include spring return; off position latch; two, three, or five speeds.



Chain Belt Co., of Milwaukee, announces the manufacture of "REX Junior", a new, light-weight, 3,000 g.p.h. centrifugal pump weighing only 54 lb. This 1½-in. pump has a large semi-steel recirculating water chamber equipped with an aluminum cap to save weight and is powered by a dependable, easy-starting, single-cylinder, air-cooled engine of ¾ to 1 hp.

Combined Respiratory and Eye Protection

MINE SAFETY Appliances Co., Pittsburgh, Pa., announces its new M.S.A. Dustfoe-Eyeshield Assembly and Comfo-Eyeshield Assembly. These units are said to furnish approved respiratory protection against even invisible particles of harmful dust, and guard the wearer's eyes from flying dust and grit by a light, durable, transparent plastic shield, states the manufacturer.

The Dustfoe-Eyeshield respirator unit is said to be compact, permits unobstructed vision in every direction, and affords protection against harmful dust. For it is claimed low breathing resistance, easy maintenance, soft sponge-rubber face cushion, foolproof exhalation valve, and protective filter cover. The Comfo eyeshield unit is equipped with twin filters of unusually large area for low breathing resistance. The replaceable filters are protected by metal covers, and the flexible rubber face

piece provides a comfortable fit on any face. All filters, for either dust, fumes, or mist, are approved by the U. S. Bureau of Mines.

BULLETINS

Crushers. Nordberg Mfg. Co., Milwaukee, Wis. The company announces a small pocket booklet designed as a handy reference for operators of Symons cone crushers. Pp. 12.

Fluorescent Lamp Starter. Hygrade Sylvania Corp., Salem, Mass. Form 181 describes the manufacturer's fluorescent lamp starter for 15-, 20-, 30-, 40-, and 100-watt fluorescent lamps. Pp. 4.

Automatic Car Holder. Portable Lamp & Equipment Co., 72 First Ave., Pittsburgh, Pa. Bulletin 4 describes manufacturer's portable car holder for use on surface or underground. Pp. 1.

Plastic Coatings. American Concrete & Steel Pipe Co., Box 3428, Terminal Annex Post Office, Los Angeles, Calif. The company offers a brochure illustrating and describing the diversified uses to which its new sprayable corrosion proof plastic coating known as Americoat may be used in industry. Pp. 16.

Battery Chargers and Rectifiers. General Electric Co. Appliance and Merchandise Department, Bridgeport, Conn. Bulletin consists of leaflet data on battery chargers and its new fan-cooled oxide battery charger. Pp. 65.

Meehanite Castings in Industry. Meehanite Research Institute of America, Inc., 311 Ross St., Pittsburgh, Pa. The manufacturers offer a comprehensive 8½x11-in. bulletin consisting of technical articles describing the various applications and industries that use Meehanite castings. Articles of particular interest to the mine operator are also included. Pp. 49.

Weight-Recording Feeders. Harding Co., York, Pa. Bulletin 43 describes and illustrates features of the manufacturer's new Feedometer. Pp. 4.

Oil Circuit Breakers. Roller-Smith Co., 1766 West Market St., Bethlehem, Pa. Catalog 3650 illustrates and describes the manufacturer's class 250-OS-150 and 250-OS-230 oil circuit breakers. Catalog 3940 describes type MS-2 oil circuit breaker. **Precision Balance.** Catalog 4540 describes and illustrates the manufacturers' new precision balance.

Flexible Bearings. Harris Products Co., 5408 Commonwealth Ave., Detroit, Mich. Bulletin 128-2, describes features of the manufacturer's Torflex bearing for various industrial applications. Pp. 4.

Sight Glasses for Pipe Lines. Cochrane Corp., Philadelphia, Pa. Publication 2970 describes and illustrates applications of the manufacturer's sight glasses for visual inspection of flow in closed pipe lines. Pp. 2. **Exhaust Heads.** Publication 2960 describes feature of an exhaust head said to insure the separation of condensate and oil from steam discharged to atmosphere. Pp. 2.

Sliding Grilles. Cornell Iron Works, Inc., Long Island City, N. Y. Bulletin describes applications of sliding galvanized-steel grilles for entrances to shops and industrial buildings. Pp. 7.

Insulators. Ohio Brass Co., Mansfield, Ohio. Catalog 24 describes and illustrates the company's materials for transmission lines, distribution lines, and substations. A feature of the catalog is detail drawings and full information on the characteristics of bushings, pin types, and suspensions. Pp. 160.

Apron Feeder. Robins Conveying Belt Co., Passaic, N. J. Bulletin 112 describes and illustrates features of the manufacturers' manganese steel apron feeders. Pp. 4.

Brazing Alloys. Handy & Harman, 82 Fulton St., New York, N. Y. Folder describes low temperature brazing alloys, Sil-Fos, and Easy-Flo that are said to have features of rapid metal joining. Pp. 4.

Tellurium Portable Cable. General Electric Co., Schenectady, N. Y. GEA-19188 describes features of the company's cable jacketed with 60 percent new rubber compounded with tellurium for use on all portable electric machinery. **How to Maintain D. C. Motors.** G. E. A.-3488 is a handy information booklet on how to maintain d.c. motors. A trouble correction chart for d.c. motors is given. Pp. 6. **Manual Motor-Starting Switch.** GEA-

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DESIGNED AND BUILT
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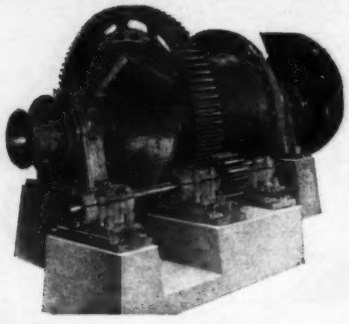

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2234C describes a small compact hand-operated starting switch for fractional horsepower motors. Pp. 4.

Potentiometer Pyrometer. Brown Instrument Co., Philadelphia, Pa. Catalog 1104 describes the company's line of pyrometers. Pp. 36.

Dust in Industry. Buell Engineering Co., 18 Cedar St., New York. The company offers an attractive brochure describing and illustrating its dust-control and collection equipment for various industrial uses. An informative section of the book is the Van Tongeren theory of dust collection. Pp. 24.

INDUSTRIAL NOTES

Chicago Pneumatic Tool Co., New York, N. Y., has engaged the services of **James P. Gillies** to assist in general sales activities. Mr. Gillies is well known in the business world, having been active in the industrial field for many years. The company also announces the appointment of **Frank B. Ridley** as manager of the San Francisco office. Mr. Ridley succeeds **H. P. Hansen,** who continues with the company in a sales capacity.

Appointment of G. A. Barker as manager of **Johns-Manville's** public utility and electrical products department was announced recently by **L. R. Hoff,** president of Johns-Manville Sales Corporation. Mr. Barker, who has specialized in the development and sale of electrical commodities, was formerly staff manager of the electrical department for Johns-Manville.

Purchase of the Lonsdale Company mill in Ashton, Rhode Island, to expand production of Fiberglas was recently announced by **Harold Boeschenstein,** president of **Owens-Corning Fiberglas Corporation,** Toledo, Ohio.

The Stearns Magnetic Mfg. Co., Milwaukee, Wis., announces expansion of its laboratory to provide more complete facilities for testing materials and for research and development in perfecting separation processes and improving its magnetic equipment.

Max W. Babb, president of **Allis-Chalmers Mfg. Co.,** Milwaukee, Wis., recently announced the appointment of **Lee H. Hill,** widely known transformer engineer, as Assistant Manager of the company's electrical department.

Centrifugal & Mechanical Industries, Inc., 146 President St., St. Louis, Mo., announces that **Francis E. Finch,** formerly President of Ruggles-Coles Engineering Co. and later vice president of Hardinge Company, Inc., is now associated with them.

Warning

A WAR DEPARTMENT WARNING has been issued against alleged coercive methods used to solicit advertising from firms holding Government defense contracts, on the part of publications which seek to assume a quasi-official connection with the Department. This announcement came as the result of a complaint from a manufacturing firm that a periodical with offices in a southwestern city had solicited its advertising through a letter creating an impression of military connections which were imaginary. Existing excellent relations between the War Department and defense industry might be threatened by such practices.

Standards for Diamond Core-Drill Fittings

A RECOMMENDED REVISION of Commercial Standard CS17-32, relating to diamond core-drill fittings, is being circulated by the Division of Trade Standards, National Bureau of Standards, Washington, D. C. Anyone interested in the subject can obtain a copy of the recommended revision on application to the Bureau.

Correction. The statement on page 134 of the Feb. issue of *E.&M.J.* that the ME 650 super charged six cylinder diesel engine of the Murphy Diesel Company, Milwaukee, Wis., has a rating of 10 h.p. was a typographical error. The rating is 160 h.p.

General view of woven wire rope making machine recently installed at the plant of A. Leschen & Sons Rope Co., St. Louis, Mo.